395936
SEP 19 1898

THE AMERICAN
GAS LIGHT JOURNAL
REDMAN&KENNY, N.Y.
PUBLISHING OFFICE No. 32 PINE STREET
DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXIX.—No. 12. Whole No. 1,215. | NEW YORK, MONDAY, SEPTEMBER 19, 1898 | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Annual Meeting, American Gas Light Association 413
EDITORIALS—
Briefly Told 414
The Niagara Falls Meeting of the American Gas Light Association—Notes.
Prevention of Smoke in the Combustion of Solid Fuels, by Mr. Wm. Bouldin, Jr. 415
Modern Appliances for the Recovery of By-Products from Coking Coal 415
The Engineering Chemistry of Boiler Waters 416
The Electric Meter's Relation to the Dividend, by C. D. Haskins—Concluded from page 387 418
Experiences with Prepayment Meters, by Mr. Andrew Wilson 419
Valuation of Crude Carbolic Acid, by Mr. C. F. Smith 420
*The Coe Bench Drill 422
*Ellin's Soldering Iron 423
On the Limits of Inflammability of Combustible Gases 423
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 423
Failure of the Proposed Opposition Scheme, San Bernardino, Cal.—Death of Mr. Samuel Bayard—Annual Meeting, Concord, N. H.—A New Manufacturing Company—Meeting, Board of Directors, Southwestern Gas, Electric and Street Railway Association—Public Lighting, Darby, Pa.—Proposing Municipal Control, Beverly, Mass.—The Milford (Pa.) Gas Ordinance—Something from Wichita, Kas.—Annual Meeting, Malden and Melrose, Mass.—Suit Over Gas Shares—The Livingston Suit Dismissed—The Paducah (Ky.) Company in the Hands of a Receiver—And Other Items.
The Market for Gas Securities 425

[OFFICIAL NOTICE.]

Annual Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY, MONTCLAIR, N. J., Sept. 6, 1898.

There will be an annual meeting of the American Gas Light Association held at Niagara Falls, N. Y., on Oct. 19, 20 and 21, 1898.

The meeting will be called to order by the President, Joseph B. Crockett, of San Francisco, Cal., at 10 A.M., on Wednesday, Oct. 19, in the meeting hall at the International Hotel, the headquarters.

The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in doing so a reply should be requested, for which a self-addressed, stamped envelope should be inclosed, as misunderstandings may thereby be averted.

The International Hotel is conducted on the American plan, and rates are as follows:

Large parlors on first floor, $3.50 per day; all rooms on second and third floors, $3 per day; rooms with bath, $4 per day. At that season of the year we will be able to have the whole house.

The meeting hall will be on the parlor floor of the International Hotel; thus the headquarters and hall will be in the same building.

The roll call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as it appears on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of application for membership accompanies this circular. More can be obtained of the Secretary.

Remember, all applications must be in the Secretary's hands by Oct. 9, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at the meeting is as follows:

"The Effect of the Depth of Fire upon the Practical Efficiency of a Water Gas Generator," by Mr. J. M. Rusby, Jersey City, N. J.

"Notes on Mains and Main Laying," by Mr. Walton Forstall, Philadelphia, Pa.

"The Loss of Illuminating Power of 25 to 30-Candle Gas when Mixed with Air," by Dr. E. G. Love, New York city.

"A Comparison between the Cost of Pumping Gas by Steam and Gas Engines," by Mr. H. L. Rice, Norfolk, Va.

A paper by Mr. E. C. Jones, San Francisco, Cal.

A short paper by Mr. Irvin Butterworth, Columbus, O.

In addition to the above there will be short topics by Mr. H. L. Doherty, Madison, Wis., and Mr. E. G. Cowdery, Milwaukee, Wis.

In accordance with the action taken by the Council and the Association last year, the Beal Medal will be awarded to the author of the best paper presented at this meeting; the question of which is best to be decided by a committee of three past-Presidents, appointed by the President.

All questions for the Question Box should be sent to the Secretary as soon as possible, in order that they may be printed in the next circular before the meeting, thereby insuring their discussion.

During the days of the meeting all announcements will be posted on the bulletin board in the meeting room. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested wear to their membership badges in plain sight, thereby greatly aiding the officers of the local committee in their work by affording a ready means of recognition.

In order that the Year-book containing the report of this meeting may be published and issued to the members immediately after the meeting—

Notice is hereby given, that if any of the speakers at this meeting desire to correct their remarks before they are printed, they will be given an opportunity before leaving Niagara Falls, but not after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meeting, and all those who desire to correct their remarks must notify the Secretary at the close of the session at which such remarks are made, as all the reports will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare

going and one third fare returning by the same route) by the several passenger associations named and under the conditions noted :

The Trunk Line Passenger Committee, covering the territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N.Y.; Pittsburg, Pa.; Bellaire, O.; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Central Passenger Association, covering the territory bounded on the east by Pittsburg, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Illinois ; on the west by the west line of Cook county and the Illinois and Mississippi rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis ; and on the south by the Ohio river, including points on either side of that river.

The Southeastern Passenger Association, covering the territory south and west of the Virginias and south and east of the Ohio and Mississippi rivers, and the Western Passenger Association, covering the territory west of and not including Chicago, Peoria and St. Louis, in other words, the territory west of that of the Central Association, have refused to grant the rates. Members from these territories should buy tickets from starting point to the nearest or most convenient point in the territory of any of the Associations granting the reduced rates, and at such point purchase tickets through to Niagara Falls and obtain a certificate.

The following extracts from the regulations of the railroads are cited for the information of the members. The special rates are granted subject to these regulations :

First. The reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.

Second. Each person to obtain the excursion rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form. Agents at all important stations are supplied with certificates.

Third. If through tickets cannot be procured at the starting point, purchase short-trip ticket to the most convenient point where such through ticket can be obtained, and there purchase through to place of meeting, requesting a certificate from the ticket agent at the point where each purchase is made.

Fourth. Tickets for the return journey will be sold by the ticket agent at the place of meeting at one-third the highest limited fare only to those holding certificates, signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary of the Association, certifying that the holder has been in regular attendance at the meeting.

Fifth. No reduction of fare will be made on the return passage if the going ticket is purchased more than three days before the opening date of the meeting ; except that when meetings are held at distant points to which the authorized limit is greater than three days, tickets may be purchased before the meeting in accordance with the limits shown in regular tariffs.

Sixth. Certificates are not transferable, and return tickets secured upon certificates are not transferable. The transfer of any such is liable to prevent the securing of reduced rates for future meetings.

Seventh. The certificate of agent at starting point, duly endorsed by Secretary of Association, must be presented to ticket agent at place of meeting, within three days (Sunday not reckoned) after adjournment of meeting. The return ticket will be for the line or lines covered by the going ticket.

Eighth. No refund of fare will be made on account of any person failing to obtain a certificate.

Special.

If a sufficient number of subscriptions are obtained, the social programme will be as follows : Wednesday evening, reception and hop ; Thursday evening, banquet to which ladies will be admitted on equal footing with the gentlemen ; Friday evening, informal hop ; Wednesday and Thursday, carriage drives for the ladies ; Friday, visit the Niagara Falls power house and other places of interest, and trolley ride down Gorge Route to Lewiston and return.

Tickets admitting members and friends to these entertainments can be had for $5 each. If you wish to join in them please sign inclosed card and return to the Secretary at once. It will be necessary to have at least 100 subscriptions.

Be sure to obtain your railroad certificate when buying your ticket for Niagara Falls, as the greater the number of certificates handed in, the easier it is to get the reduction in rates for future meetings.

Apply for tickets and certificates at least 30 minutes before train time.

Each person must sign his own certificate at time of purchasing for Niagara Falls.

Be sure to hand the Secretary your certificate as soon as you reach the headquarters.

Apply for return ticket at least 30 minutes before train time, and have your certificate with you.

Any person, ladies included, attending the meeting, is entitled to the reduced rate from the territories named.

Members will please hand their certificates to the Secretary, or his clerk, upon arrival at place of meeting. If there are 100 members present, holding certificates, each certificate will then be properly indorsed and handed back to owner, before adjournment.

Extracts from the Constitution.

Sec. 12. Application for active membership, or for associate membership, or for transfer from associate to active membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

Sec. 51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

Sec. 52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

ALFRED E. FORSTALL, Secretary.

BRIEFLY TOLD.

THE NIAGARA FALLS MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.—No doubt Secretary Forstall's well put together circular, respecting the preliminaries of the twenty-sixth annual meeting of the American Gas Light Association, has been carefully studied by those interested in the details which it conveys. In that understanding little is left us to say in way of comment that would add to its instructiveness, but it may be remarked here that the outlook for the success of the meeting is perfectly clear. The Committee of Arrangements, after much persistent work and convincing argument, succeeded in obtaining concessions from the proprietors of the International Hotel, Niagara Falls, which virtually put the Association and its guests as the sole occupiers of the hotel during the times of the meeting. The real meaning of this will be fully appreciated by those who have travelled much, in that it means freedom from intrusion. The Committee is also to be congratulated upon the terms secured and upon the clever entertainment programme outlined. As far as the technical side of the meeting is concerned, the paper list given by Secretary Forstall assures success in respect thereto ; and this year the paper writers will have the satisfaction of competing for the gold medal, offered last year by Mr. W. R. Beal, of New York, for the best treatise read. It might properly be added that the Beal Medal is to be contested for at subsequent meetings. Those proposing to take membership in the Association should pay due heed to the Secretary's instruction that all such applications *must* be in his hands by October 9th. It is hoped and believed that the attendance of the members will be this year well beyond the average, for an exceptionally important thing that will come up for consideration is the planning to carry on the good work so successfully and unselfishly inaugurated by the Association's committee on educational work.

NOTES.—The New York *Herald*, of last Tuesday, emitted a characteristic yaup, the burden of its childish wail being that the Metropolitan Street Railway Company, through having capacity for generating electric currents beyond its motor needs, was going into the lighting business on a tremendous scale. Then follows the reporter's prediction that such purpose meant trouble, perhaps ruin, to the local gas companies. Bring on your ruin, gentlemen. The gas men of this city have been ruined many a time and oft, hence we are used to the distress that such ruin brings. And, strange to say, the only people in the lighting business of whom gas men are afraid are themselves ; they will differ over internal questions and policies. Meanwhile we would advise that holders of shares in the fairly capitalized gas companies of the city should not exchange such holdings for "equal parts" in the securities of the Metropolitan Street Railway Company.——The internal revenue authorities assert that, under the existing laws, every receipt given by a gas company to a consumer, for a deposit by the latter insuring the payment of his bill, must bear a 2-cent stamp.——Write to Messrs. George M. Clark and Company, of Chicago, for a copy of their excellent 1898-99 catalogue of Jewel gas heaters and radiators. ——The Trustees of the natural gas supply system on municipal account for Toledo, Ohio, have entered into a contract with Clifton Geddes to help them out of their difficulty—the supply of natural gas has been steadily failing in Toledo. Geddes agrees to furnish the authorities with "any quantity" of artificial fuel gas, made under the Bidelman process, at the rate of 18 cents per 1,000 cubic feet. The contract is to run for five years. Next week we will have something more to say about this.

[Communicated Article.]

Prevention of Smoke in the Combustion of Solid Fuels.

By Mr. William Bouldin, Jr.

Your extract (Journal, Sept. 5, page 338) from the *Gas World*, regarding the recently concluded official tests in Paris, France, of various forms of steam boiler furnaces for smoke prevention, seems to be in conflict with the full and detailed statements thereon in *Le Genie Civil*, signed by the engineer who conducted the tests. The Hinstin furnace, referred to by you on the authority of the *Gas World*, as having taken first prize, received "honorable mention." The first prize was given to no one exhibitor, but was divided between M. Donnelly and James Proctor.

The Donnelly furnace seems to have depended upon coking the fuel. The Proctor furnace is a slightly new arrangement of the old plan of a step down from the door plate to the main grate and from this grate to the floor of the pit in front of the bridge wall. The latter furnace seems to have been automatically fed.

The fuel used was briquettes. Therefore the tests in question were made upon fundamental conditions which do not apply either in this country or in many others. In the use of briquettes it will at once be seen that the interstices for the circulation of the air through the fuel are much greater than, for instance, had bituminous coal been used.

The judgment of the engineers in charge of the tests in question was also to the effect that the greatest economy in fuel was secured in the presence of the production at a small percentage of smoke.

While smoke is one of the evidences of imperfect combustion, though not nearly such an important one as the presence of a large body of CO, the judges may have been wise in their final opinion, for by the use of too much air in the furnace not only is smoke practically entirely prevented, but the work of the boiler is materially reduced. This is no doubt what they found to be the case, as all other thorough experimenters have found before them. The trials brought out actually nothing new in combustion, and little that is new in the mechanical handling of the fuel.

The Journal is to be congratulated upon its judgment in giving some attention to this most important problem of the economical combustion of fuel. It will become more important, so far as the attention of stockholders and officers of industrial enterprises is concerned, from this time on. Feeling its importance I have made a study of it and have watched the growth of the efforts of students and inventors both at home and abroad to better existing wasteful conditions with a great deal of interest, and though familiar with possibly every recognized effort, from the first of ancient history to those of the immediate present, to bring out a mechanical method which would permit of the operation of the chemical law under which combustion operates, I regret to say, admitting that great progress has been made, the method has yet to be introduced which fulfils my idea of (1) simplicity; (2) low cost; and (3) convenience of installation—three conditions which must exist in addition to efficiency to render an appliance vastly popular.

In conversing with men of importance, users of large supplies of labor and fuel, savers and makers of money on the large scale, I have been astounded at the lack of knowledge upon this general subject and the lack of interest in this special line. The assumption seems to be that there have been so many devices of a worthless character exploited that there is nothing of sound character to be had. Even though perfection is not yet upon us in this respect, I will state without fear of intelligent contradiction—contradiction founded upon good reasons—that nine-tenths the power plants of this country can save thousands of dollars annually in each individual case where old knowledge and methods are found good enough, and where the consumption of fuel is considerable. I know of one case where owners were persuaded to pay for and listen to expert opinion. The "rule of thumb" business, as it applied to combustion (the only place in the works in mind where it did so apply), was cut off. Intelligent effort, based upon up to-date knowledge, was substituted, and the result was a saving in the fuel account of over $4,000 per month, $48,000 per annum, or $4\frac{8}{16}$ per cent. on a million dollars, at a cost trifling in comparison with the returns from the investment.

Owners and managers, however, do not know which way to turn. Every manufacturer claims "the best" appliance. All can't be tried, so generally they are all thrown aside, "rule of thumb" is instructed not to use so much fuel; so, to keep steam up, a little more is thrown on and they "let it go at that."

Modern Appliances for the Recovery of By-Products from Coking Coal.

[Translated from the German, for the *Am. Mfr.*, by Mr. R. Terhaerst.]

The chief purpose in coking coal is to produce a pure, smokeless and flameless fuel, which possesses in a high degree the property required in blast furnace and foundry practice, namely hardness. For a long time it was believed that such a coke could be produced only in the ordinary coke ovens where the oven gas is used directly as fuel. The later systems of coke ovens, the so called retort or by-product ovens, were looked upon with a certain suspicion, and in the beginning it was even devised that those ovens could produce a serviceable furnace or foundry coke. It was pointed out that by the removal of the by-product from the gas the heating value of the latter was reduced, while the quality of the coke itself was injured by the exhaustion of the gas from the oven. To-day those prejudices have been dropped, and the conviction seems to have become general that the heating value of the gas, even after the removal of the by-products, is altogether sufficient for a successful cooking process, while besides tar, sulphate of ammonia, benzol, etc., a coke is produced which answers metallurgical requirements in every respect.

Furthermore, there is furnished by by-product plants a considerable surplus of gas which in connection with the waste heat from the ovens is most suitably utilized in heating the boilers. One 60-oven battery in Westphalia, for instance, yields a gas surplus of 84,700 cubic feet, a quantity which is sufficient to heat boilers possessing an aggregate heating surface of about 3,800 square feet. The heating value of 84,700 cubic feet of such gas corresponds to that of about 21 tons of coal. But not only as boiler fuel can this gas be utilized, it may also serve for illuminating purposes. In this case, of course, it has to pass through purifiers as in illuminating gas factories, and afterwards it has to be carbureted.

Carburation, that is, the intensifying of the illuminating power by the introduction of hydrocarbon vapors, can be accomplished at the cokeries simply by the oils residuary from the distillation of the commercial benzols, which possess the advantage of being very cheap and not too volatile. Supposing the average annual gas consumption per inhabitant to be 1,765 cubic feet, the gas surplus from a 60-oven battery would suffice to provide a city of 86,000 inhabitants with light.

The course of the coking process is naturally of great influence on the quality of the coke. This influence becomes evident, not only by the appearance of the coke, but also by its weight. Too quick a degasification or formation of coke is not advisable with by-product ovens, as the coke becomes too porous, and the nature of the by-products is much affected by the high temperature.

It has generally been observed that with an oven working very hot, both quality and quantity of tar are unfavorably affected. The grouping of the molecules in quick coking, and at very high temperature, also differs materially from that in slower coking and at lower temperature. Tar forming at very high temperature contains more benzol and toluol, but also more naphthaline and other solid bodies, while, when forming at lower temperature, it is specifically lighter, and consists principally of volatile hydrocarbons. This is proven by the fact that the supposed improvement of coke ovens by increasing their working temperature has resulted in the production of tar that is very rich in benzol. This circumstance, it is true, is very favorable for such cokeries where the benzol is recovered from the distillation of the tar, and not by the washing of the gas with tar oils and subsequent distillation. If the latter method is to be followed, which is decidedly the more profitable as regards the yield in benzol, the coking process should not be too quick, although it is hardly necessary to prolong it to more than 48 hours.

The exhaustion of the gas is another important point; it has to be carried out according to its development. There is also to be considered the proportion between the gas pressure in the oven and the heating flues. If there is any over pressure in the oven the crude oven gas with its contents in by-products might be forced through cracks in the brickwork into the heating flues and be burned up. On the other hand, with over pressure in the heating flues the heating gas may enter the oven and destroy the by-products. To insure a gradual degasification the coal is wetted before charging. The steam thus produced at the beginning of the coking process absorbs large quantities of heat, and causes but a slow increase in heat, which results in the gradual disengagement of the gas from the coal charged. With dry coal, the development of gas is very violent at the beginning. The forcibly escaping gas loosens the charge and carries finer particles of it along.

The gas developed in the ovens passes through a vertical pipe into the joint gas channel which is arranged above the ovens. Frequently the gas channel is provided with hydraulic valves which are intended to prevent the flowing back of the gas when an oven is opened. This apparatus is in action for a short time only, that is as long as the oven is open, while during the whole coking period the gas has to overcome the pressure of the hydraulic valve. Considering that hereby quite a considerable pressure is caused in the ovens, and further that an easy exit of gas from the charge has much to do with the production of a compact and strong coke, we must arrive at the conclusion that hydraulic closure exercises an injurious effect on the coking process. Free passage should be provided for the gas, and this is done by a dry exhaust which is usually carried over a battery of 30 ovens. Such an exhaust offers to the gas a considerable cooling surface, so that a large part of the total tar is separated in it in hot condition. The thin and the thick tar and the dust products combine to a thinly fluid mass, which flows down the slantingly arranged channel immediately after its formation, and without having time to become thick. The vertical pipe leading out of the oven into the collecting main is provided with a knee and a valve which is closed as soon as the charge is finished, so that during drainage and charging no air can enter the main. On the upper side of the knee there is a small hopper valve which opens when the gas pressure in the oven is too strong, and allows the gas to escape into the air.

The two collecting pipes of a plant, consisting of two 30-oven batteries, unite in another inclined tube of sufficient width through which the gas is conducted to the coolers. The tar condensed in the collecting mains is carried off at the ends of the batteries.

Exhausters provided in the condensing plant force the gas from the collectors into the tar separators through which the gas travels in a circuitous route and with slow speed, thereby giving up another large part of its tar contents. To prevent an over-pressure or vacuum in the ovens the exhausters are provided with governors and escape valves, which become active in the case of a stoppage of the exhausters.

After the gas has reached the coolers, which are operated by air or water, or both combined, it is necessary, in order to retain as much benzol as possible in it, to effect a gradual but strong cooling, and a slow circulation of the gas, as thereby is obtained a higher benzol content in the gas and a better separation of the heavy components in the form of tar low in benzol. After having been freed from its tar contents the gas passes over to the ammonia plant. It first enters the scrubbers, consisting of a series of wooden trays, arranged one above the other. While the gas flows upward the trays are irrigated with water from above, so that gas and water are brought in intimate contact in opposite directions, and on a large surface. Considering that at low temperature the absorbing capacity of the irrigating water is maintained for a long time and by repeated use the water can be enriched to a strong ammoniacal liquor, it is advisable to cool it at its leaving the scrubber.

The gas thus freed from its ammonia contents is now treated for the recovery of benzol. This is done by conducting the gas towards a fine spray of tar oil which eagerly absorbs the benzol contained in the gas. The oil is a product recovered in the distillation of the tar, and is used repeatedly for spraying until it has been fully enriched with benzol. The latter is then separated by fractional distillation, while the residuary oil is again used for washing. The main part of the gas is now led back to the well and sole flues of the coke ovens, while the surplus can be utilized for heating boilers and stills for operating motors, for lighting and other purposes. Before reaching the coke ovens the gas has to pass through a pressure regulator which is adjusted so as to equalize pressure and insure uniform temperature in the ovens.

The tar recovered in the manner described above is pumped from the collecting pits into elevated tanks, and from there conducted to the stills. To insure a smooth distilling process, the tar should be as free from ammoniacal liquor as possible. After the tar oil required for the benzol process and other products have been distilled off, the residuary pitch can be utilized in the manufacture of coal briquettes and for other purposes.

The ammoniacal liquor which separates in the collecting pits from the tar is, like the tar, pumped into an elevated tank from which it flows to the ammonia apparatus. The liquor which usually contains 1.2 per cent. ammonia, enters the apparatus from above, and runs down from column to column. Injectors arranged at the bottom of the apparatus keep the liquor in lively circulation. To recover the ammonia, lime water is continuously introduced into the apparatus, whereby the ammonia is volatilized in a short time. The ammonia vapor is conducted into sulphuric acid, and precipitated in the form of sulphate of ammonia, which by drying or centrifugating, is finished to fertilizer for the market.

The benzol bearing oil is distilled in large wrought iron stills. The first running, consisting of ammonia liquor and light oil, is collected in one vessel, in which they separate according to their specific gravity. The liquor is piped to the ammonia plant, while from the light oil crude benzol is recovered in a special still, provided with one column. The residuum from this process is again used for washing the gas. The column on the still, in connection with a dephlegmator, is for the purpose of retaining the heavy oil that has been carried along. The crude benzol is purified by treatment with acid, lye and steam, and thus freed from its resinous components.

According to this method there were obtained from one ton of standard Westphalian coking coal 10.85 kilos, or about 24 pounds of benzol. The charge per oven was 7 tons, containing 10 per cent. water; the coking period was 48 hours. The benzol produced had a specific gravity of .879.

The Engineering Chemistry of Boiler Waters.[1]

Pure water is an artificial product of the laboratory, and is so difficult to prepare and preserve that its properties can hardly have any practical importance. Natural waters always contain substances in solution and suspension, varying from mere traces to very large amounts. The effects and uses of water are dependent upon the character and amount of the materials present.

The suitability of water for boiler purposes must be considered with reference to the two properties of corroding and scale forming. These are, to some extent, antagonistic, since the deposit of material on the iron will, of course, protect it. Experience shows that waters of very high purity are by no means always the best for boiler use. In general, it may be said that the corrosive qualities are due to the water molecule itself or to the oxygen and carbonic acid present in solution. More rarely, we have organic or mineral acids, and these, especially the latter, are highly objectionable. Organic acids of somewhat indefinite character result from oxidation of vegetable matters, especially the cellulose and lignin of wood fiber; hence, waters collected from swampy regions, in which there is necessarily much decaying vegetable fiber, may contain organic matter in a corrosive form, practically acid, although perhaps not corresponding exactly to the strict definition of that term in modern chemistry.

The water supplied to Sheffield, England, is derived from peaty moorlands, and sometimes has a strong action on iron. In one stage of the flow the acidity is equal to about ½ of a grain of sulphuric acid to the gallon. As these acid-like substances are often not volatile, the concentration of the water in the boiler greatly increases the corrosive action. Even when the organic substances are not capable of acting as direct corrosive agents, they may indirectly determine the oxidation of the iron. The laboratory affords us more than one instance of the formation of a body being promoted by conditions favorable to its combination when formed, and it seems possible that any organic matter which is readily converted into acids by moderate oxidation would be capable, under the joint action of free oxygen and a distinctly positive body, such as iron, of forming a soluble iron salt, although neither the oxygen nor the iron alone would accomplish the action.

An important commercial process may be cited as an example of this: Finely divided vegetable matter, such as sawdust, is readily converted into potassium oxalate by heating with caustic potash; and from this product oxalic acid, one of the strongest acids known, may be obtained. Vegetable matter is not converted into oxalic acid by the action of air alone or mild oxidizing agents.

Some years ago, when studying the Anderson process of purifying water, I had occasion to note an action which seemed to be explicable on this theory. A sample of water was received from the neighborhood of Norfolk, Va. It was deeply colored with organic matter. On agitating it with iron turnings in a partially filled bottle for a few minutes, a bulky precipitate was formed, and on filtration a colorless water was obtained, tests of which showed that 97 per cent. of the oxidizable organic matter had been removed. It seems probable that somewhat similar action would occur in a boiler, and that a material corrosion of the iron would ensue, for in the experiment noted above a notable amount of the iron was converted into ferric oxide.

It is hardly necessary here to speak of the injurious action of mine waters. In most cases they owe their acidity to sulphuric acid derived from the oxidation of pyrites, and exercise a powerful and constant corrosive effect on iron, even in the cold.

1. From a paper read by Mr. Henry Leffman, before the Engineers' Club, of Philadelphia

I have lately had occasion to examine two waters which have marked corrosive qualities, although they do not show excess of organic matter or marked acidity. They are of somewhat different composition. One contains about 6 grains of solid matter to the gallon the other about nine. Their corrosive effect is exerted on other metals than iron; indeed, with regard to both samples, the most serious complaint is that the soldered joints in the lead lining of the flush-tanks are destroyed. One of the samples was sent with the information that everything was corroded except the copper portion of the ball on the valve rod. This statement led me to suspect the presence of a copper salt, but none was found. Copper and lead salts will prove very corrosive to iron.

The quantitative examination of these waters has shown that in both the amount of magnesium and chloride is high in proportion to the other solids. This suggests the view that the corrosive action is due to magnesium chloride as noted below.

The corrosive action of the soluble chlorides on common metals is well known. Practically only sodium chloride and magnesium chloride come into consideration. Sodium chloride is present in almost every sample of water, but in surface and subsoil water, unpolluted with sewage, the quantity is usually less than one grain per gallon. In deep waters its amount is often quite large. Thus, in the well (over 400 feet deep) on Black's Island, just below the mouth of the Schuylkill River, the sodium chloride exceeds 50 grains per gallon. Such a water would be expected to exert a decidedly corrosive action.

Magnesium chloride is generally considered a highly objectionable ingredient by reason of its liability to a reaction with water, by which hydrochloric acid is formed. It is known that magnesium chloride cannot be obtained pure by evaporating its solution in water; the residue will contain some magnesium oxide, while hydrochloric acid escapes. The water takes part in the reaction:

$$MgCl_2 + 2H_2O = MgH_2O_2 + 2HCl.$$

Some experiments that I have made indicate, however, that this reaction does not occur until the solution becomes concentrated. However, we must bear in mind here the principle that has been stated in connection with the effect of organic matter, namely—that the presence of iron may promote the reaction by offering an opportunity for the action of chlorine. The experiments of evaporating magnesium chloride in glass, porcelain or platinum vessels do not represent the conditions in practice, and the reaction

$$MgCl_2 + Fe + 2H_2O = MgH_2O_2 + FeCl_2 + H_2$$

might occur under conditions which would not bring about the former reaction.

To be on the safe side, some chemists have advised that the magnesium and chlorine determined in the analysis should be so expressed as to show the maximum amount of magnesium chloride that could be produced from the water, and thus determine the upper limit of a corroding effect from this source.

Even supposing we have no substances in the water capable of acting directly on iron, it is not likely that any boiler will escape some corrosion, for commercial forms of metals are not usually homogeneous, and the contact of water containing appreciable amounts of mineral solids will establish a polarization in which one portion of the iron will become the positive plate in a voltaic couple and suffer corrosion in consequence.

The gases dissolved in water are usually nitrogen, oxygen and carbon dioxide; the last is assumed to exist as carbonic acid. Nitrogen is regarded as without effect, but the others are important. Spring water of high class—that is, containing very little dissolved solids—often produces marked corrosion. Some years ago one of the large trunk line railroads had much trouble from boiler corrosion on a division which was supposed to furnish excellent water. The road had a well equipped laboratory, but the chief of that department assumed that the corrosion was due to free acid. He held to this view stubbornly, and in defense of it had numerous analyses made and considerable volumes of the water evaporated in order to concentrate the acid which was not there. The examination showed that the corrosion was due to the dissolved oxygen, probably assisted by the carbonic acid. The water contained so little scale forming material that no protecting film was formed on the iron, and hence it was exposed to the direct corrosive action of the water and the contained gases.

The solubility of oxygen in water is greatly diminished by heat, while chemic activity is increased. Hence, the cold water charged with oxygen entering the boiler has this oxygen released from solution and it attacks the iron. The corrosion is, therefore, apt to be most marked at the point at which the feed water enters. The presence of the free oxygen and its increased activity probably also assist the corrosive action of the carbonic acid. The reaction—

$$Fe + H_2CO_3 = FeCO_3 + H_2$$

is unlikely, but—

$$Fe + O + H_2CO_3 = FeCO_3 + H_2O$$

is not improbable; indeed, it is supposed to occur in some cases in the Anderson process for purifying water.

When the amount of scale-forming ingredients is sufficient to produce a film on the iron, it is protected from such immediate corrosion, and we are reminded of the conditions which occur in the human mouth—the decay of the teeth, and the deposit of tartar are antagonistic conditions and do not occur at the same spot.

Two other influences toward corrosion may be mentioned:

Unpolluted waters usually contain but small amounts of nitrates, but waters drawn from shallow wells in populated districts generally contain notable quantities, probably in the form of calcium and magnesium nitrates. These are corrosive salts, and, as the determination of the nitrogen existing as nitrates is easily made by modern methods, it should not be omitted by the analyst. If the proportion exceeds a few parts per million it should be given consideration.

The fatty oils may lead to the production of corrosive substances. These often contain free acid, and the proportion may be increased in the boiler, since high steam decomposes the fats and oils, producing a fatty acid and glycerol. The mineral oils are hydrocarbons and are not subject to such decomposition, and hence are not likely to form acids. In fact, they exert rather a reducing action and might restrain corrosion.

Turbid waters should be filtered before being used in boilers. If filters using alum are applied, care should be taken that an excess of alum (or aluminum sulphate) be not used, as decided corrosion might be produced.

The scale forming ingredients in water are principally the compounds of calcium and magnesium. Usually the amounts of silica and iron are not sufficient to produce marked deposits. Calcium and magnesium exist in natural waters principally in the form of sulphate, carbonate or chloride, and the amount and character of the scale will depend, to a great extent, upon the form of combination. Magnesium and calcium carbonates are but slightly soluble in pure water, but are rendered much more soluble by the presence of free carbonic acid. This is usually expressed by saying that the substances form soluble bicarbonates, but the term is little more than a form of words. Whatever be the condition, it is well understood that it is disturbed by the removal or neutralization of the free carbonic acid, when all but the small quantity of the carbonate soluble in the pure water is precipitated. In the ordinary use of water the removal of the carbonic acid is brought about by the heating, and deposits of the carbonates promptly take place. The amount of such deposit is, therefore, independent of the concentration which the water suffers.

Magnesium sulphate is freely soluble in water under all ordinary conditions, and need not be further considered. Calcium sulphate is one of the most objectionable ingredients in boiler water. Although often described as an insoluble salt, it is soluble in cold water to the extent of over 100 grains to the gallon. At the boiling point it is somewhat less soluble, and at temperatures decidedly above this, say 300° F., which correspond to about 60 pounds pressure, it is nearly insoluble. Now, it is a well-known principle that insolubility controls chemic interaction. Hence, water containing calcium compounds and sulphates would be expected to form a precipitate of calcium sulphate in such amount as to exhaust one of the ingredients that are needed to form it—that is, until either the Ca or the SO_4 is used up. Possibly the presence of considerable amounts of chlorides or potassium or sodium carbonate would mitigate this condition, but in most instances, I think, it will be safe to apply the same rule that is given for the estimation of magnesium chloride, namely—base the judgment on the maximum amount of calcium sulphate that the water could yield under any condition.

In response to an inquiry, Dr. Dudley has kindly given an outline of the method used in the Pennsylvania Railroad laboratory at Altoona for the approximate determination of scale-forming ingredients. The total solids are determined in the usual way, the residue is treated with dilute alcohol (50 per cent.), and the undissolved matter is designated scale-forming material. The method is found to be satisfactory in its application.

Any condition that promotes the insolubility of the calcium sulphate will, in some measure, represent the effect of heat, and hence the amount of precipitation obtained by adding alcohol to the concentrated water will be of value in determining its incrusting tendency.

Although the various materials which deposit in boilers are often collectively designated as "scale-forming," yet, as is well known, the different material differs much in the character of the material deposited. The carbonates produce a soft scale, calcium sulphate a hard scale.

Mr. E. F. Smith has called attention to the fact that some manufacturers at Manayunk, Philadelphia, have been obliged to abandon filters requiring alum on account of the marked increase of hard scale which is brought about. This is easily explained; the alum introduces a notable amount of sulphate into the water. Probably aluminum chloride could be substituted with advantage in these filters.

In that portion of the deposit in direct contact with the hot iron the precipitated magnesium carbonate becomes converted by the combined influence of the heat and water into magnesium hydroxide and carbonic acid.

$$MgCO_3 + 2H_2O = MgH_2O_2 + H_2CO_3.$$

Hence many boiler scales show notable amounts of magnesium hydroxide without necessarily indicating that it is due to the decomposition of magnesium chloride.

As engineers cannot control the laws of nature, and often have no choice of water, the question is then, what may be done to remedy the objectionable conditions? Turbidity may be easily remedied by filtration. In the technical uses of water a mere straining effect is needed; the removal of bacteria and the mere opalescent suspended matter is not necessary, hence less care is required in the operation of the filtering apparatus than when sanitary questions are involved. I have already called attention, however, to the danger of the too free use of aluminum salts.

When corrosion is due to free acid it may be easily overcome by the use of alkaline substances, among which caustic soda and soda ash would be most generally applicable. The corrosion due to the decomposition of the magnesium salt would be benefited by almost any of the methods adopted to prevent scale, which will be considered later. The corrosion due to dissolved oxygen will be materially reduced by heating the feed-water, and also by arrangements for not allowing the water to come directly in contact with any highly heated spot.

The prevention of scale is secured in various ways. The magnesium and calcium carbonates that may be held in solution by carbonic acid are all precipitated by the removal or neutralization of that acid. The former may be accomplished by the heating of the water, or even by exposing it in thin layers to the action of air; the neutralization can be brought about by the addition of some basic substance. One of the oldest methods is the addition of slaked lime, calcium hydroxide, which, by converting the carbonic acid into an insoluble carbonate, precipitates both itself and the carbonates in solution. Caustic soda will also accomplish this.

The precipitation of calcium sulphate cannot be so easily accomplished. It is soluble in water to the extent of over 100 grains to the gallon. It does not owe this solubility to any other substance, and it is not much less soluble at the boiling point. If the precipitation is to be accomplished by heat alone, it must be under decided pressure, as exhaust steam will not produce the same effect as it will with dissolved carbonates. Calcium sulphate being a most objectionable ingredient, much attention has been given to the methods of removing it or preventing it forming hard scale. The older remedies mostly involved the use of organic matters, which acted by interfering with the crystallization of the sulphate, and thus rendered the deposit pulverulent, or at least friable. Much organic matter, however, in a boiler water may cause corrosion or priming, and we find a tendency at the present day to the use of direct precipitating agents, among which may be mentioned trisodium phosphate and sodium fluoride. Both these substances convert all calcium and magnesium compounds into insoluble flocculent precipitates, yielding also highly soluble and non-corrosive sodium salts. They seem to meet the practical issues very well, and are in extensive use.

[*Concluded from page* 387.]

The Electric Meter's Relation to the Dividend.

[From a paper read by Mr. Caryl D. Haskins, before the Ohio Electric Light Association.]

Another common error made in installing meters in connection with motors—and sometimes in connection with lights too—is the placing of the meter on the load side of the main switch. I suppose that is done with motives of economy, because when the main switch is open the energy which traverses the shunt coil of the meter is cut off. All meters which have shunt field coils must of necessity be wound with extremely fine wire. Every time the main switch is opened that fine wire cools off and contracts; every time that the main switch is closed that fine wire heats up and expands, and speedily the meter is open-circuited in the shunt field coil.

Until they have tried it, very few appreciate how easy it is to keep meters clean. With the average installation a visit to the meter for the purpose of cleaning twice a year is ample—sometimes three times a year where the point of installation is not a clean one. With a bellows all the loose dust which is liable to work into the bearings and enter the brushes and clock train can be blown out. With a piece of tape a commutator meter can be cleaned in about a minute and a half. Altogether, the operation of cleaning out the meter should not consume more time at the meter itself than five minutes per visit—ten minutes a year! This is a very small sacrifice in wages to make for the return obtained owing to light load accuracy. Sometimes people say to me, "but since we begun to clean our meters we began to get a lot of kicks." I think that tells the story at once. They began to get a lot of kicks because they had been running a long time with dirty meters.

As to testing meters, many stations have a practice of removing a meter to test it. They change their meters once a year. I don't believe it is necessary, except under very rare conditions, to remove a meter from the point of installation to test it. There are a good many simple and accurate ways of testing a meter at the point of installation which do not involve creating distrust in the mind of your customers. On direct current service and also on alternating current service where there are no inductive loads the method with ammeter and voltmeter is not to be despised; it is accurate, but is sometimes cumbersome. Better than that is the use of an indicating wattmeter, which when cut in with series coil in the field of the meter and potential coil in multiple with the armature of the meter gives an immediate indication of the watts in use. But even that method, I think, is inferior to one which is just beginning to come into favor, and which has proved a great success. That is nothing more than the use of a box of calibrated lamps. With a calibration card showing the consumption at various voltages and a voltmeter this gives good results. The lamps, if they are selected for a potential higher than that to which they are to be exposed, will retain their wattage for a surprisingly long time. It is also a method which appeals to the consumer. He knows what a lamp is. I have come to be a great believer in teaching the customer how to read and how to test his own meter. Meters are made pretty well to day, and I think it is a good thing in the long run to have the customer so well armed with a very little simple information that he can turn on a number of lights in his house, and go down and watch the meter and satisfy himself that it is right.

Lately two entirely new propositions in connection with the meter problem have developed, and they have grown, I believe, up to a point where they will soon become the strongest kind of modifying influence on the earning capacity of the central station. I refer to the rate-modifying systems, such systems as the 2-rate and the Wright demand.

The 2-rate system is just what its name indicates. It is a system which, between certain hours of the day, changes the record of your meter from dial No. 1 to dial No. 2; and your customer pays on his high rate dial one price for the current that he uses during the peak and on his low rate dial another and much lower price for the current that he uses at other times than that of the peak. The determining of those two rates is strictly a local issue. Theoretically they should be determined by charging the peak customer the low rate plus his proportion, according to the amount he uses, of the interest, depreciation and investment charges on the apparatus maintained for the purpose of carrying the peak alone. Some central stations have found it a possible and profitable basis to make the low rate about one-third of the high rate or peak charge. It has been pointed out that after the system was established for a time the peak would change. That is just what is wanted. That hump should extend until the valleys are filled out like grading a piece of ground.

There is a large class of customers who use light almost exclusively in the valley periods and who to day, to a large extent, cannot be reached at all by electric light, for the simple reason that the rate is too high; but with the two-rate system gas rates can be met and strong inducements offered them.

It seems to me it is essential to the success of any multiple-rate system that the factor which changes the rate should be purely dependent on the occurrence of the station peak. There are systems which, instead of making the change of rate dependent upon the station peak, make it depend upon the local peak. If the local peak and station peak are coincident, this would be perfect, because it is somewhat a

simpler system than the other; but the local peak is more commonly not coincident with the station peak than coincident with it. If the rate system makes the modifications depend upon the occurrence of a local peak, it seems to me that it punishes a class of customers who should be encouraged and not punished. If a very heavy load between 11 in the forenoon and 3 o'clock in the afternoon can be obtained, even though that load be a local peak, it is a profitable one. If a lot of distributed peaks can be obtained, overlapping one another and filling out the valley of the curve, it realizes what all central stations want to accomplish—a load curve which enables them to run as nearly as possible with the whole equipment at a fair load 24 hours a day.

The prepayment system is now being adopted in some cities, and will, I believe, be very widely used. It merely consists in a meter into which the customer drops his money in payment of his bill before he can get his light. It is simple, and in the large cities it seems destined to accomplish quite a revolution in electric light. It lets the illuminating company into whole sections of cities which to-day are closed from the mere fact that the people who take the light in those districts have no credit. They move every two weeks; and yet those people are the very ones who are the most extravagant in the expenditure of their money. They pay a high price for everything; and it has been proved quite conclusively in Europe that those people will use light in large quantities provided they pay for it in small installments. Such meters open up the slums of the larger cities, and even in smaller cities of the manufacturing class they open up great districts which to day are either not available or not profitable, by reason of the great number of defaulted bills.

Experiences with Prepayment Meters.

[A paper read before the North British Association of Gas Managers, by Mr. Andrew Wilson.]

The introduction of these instruments for the control of the delivery of gas to the consumer marked a new epoch in the history of lighting by gas. By their means it became possible to include as consumers a class "whose room was preferable to their company," before their introduction, but who may now be looked upon as the best paying class of consumers.

Fully two years ago these meters were introduced in Perth, and, as the popular saying goes, they immediately "caught on," so that at the present time over 1,100 are in use. Of these, fully 800 are supplying gas to new consumers; the remainder to bad payers and those who found a quarterly account too much of a sudden drain.

A certain amount of caution had to be exercised in fixing these meters, as applications for them were at first received from old consumers, despite the fact that the bulk of them were well served, and could well afford to run a quarterly account without feeling any inconvenience. However, in course of time these unnecessary applications c ased to come in, and now applications are only received from new consumers, or from those who have compulsorily or otherwise ceased to be consumers by the ordinary system. A considerable number of these meters are fixed in conjunction with a griller, boiling ring, or cooking stove, which latter are fixed free of charge.

Prepayment meters fixed in this manner are greatly in favor with lodging house keepers. Last year the average number of these meters in use in Perth was 1,020; the average consumption being 6,000 cubic feet per meter. The gas rate in Perth is 79 cents per 1,000 cubic feet; and 20 cubic feet are supplied for 2 cents, or at the rate of $1.04. The extra revenue from this source was therefore $1.50 per meter, or a total of $1,530. This sum we find covers the interest at 3 per cent. on the extra money expended on these meters, pays the working expenses of the system and leaves a handsome balance.

The bulk of the meters are 2-light drys, costing $9.62 each, or $4.72 more than the ordinary 2-light meter. This sum, at 3 per cent. on 1,020 meters, means $144.70 per annum. A collector and a boy assistant are continually employed collecting the coin, at the respective wages of $7.25 and $1.25 per week, or a yearly sum of $443. After deducting these two sums we still have the respectable total of $943.30 as the net profit by the use of this system over the ordinary one. You will observe I charge all the collectors' wages to this system, which I think I am entitled to do, as extra assistance was required shortly after its introduction.

The working of these meters entails more labor than the ordinary meters, as the coin collected weighs considerably more than a survey book, and the collector may have to call six times before finding the consumer at home. The bulk of these consumers are millhands, and those whose work necessitates their being from home all day. Thus the collector's work is considerably increased from this cause. We find it also necessary to provide the collector with a light two-wheeled barrow to transport the coin, and a boy to be always in attendance on it.

Several short paragraphs have appeared lately in the West of Scotland papers giving the weight of copper taken by certain gas undertakings from these meters during one month. The figures I forget at present; but Perth with its modest 1,020 prepayment meters collected last January 10 cwt. 2 qr. 18 lbs. of coppers from them. Such was the scarcity of coppers in the city during the month that it created serious inconvenience to several of the large shopkeepers, who besieged the gas offices clamoring for change. The matter was brought under the notice of my Committee, who could not, however, see their way to remedy it. Over the year, we collected 306,000 pennies, weighing 2 tons 14 cwt. 1 qr. 19 lbs. Such is Perth's record.

Regarding the meters in use, they are all of Scotch make, and have given us every satisfaction. Of course, at times, they have got out of order; but we found that this was oftener attributable to the fault of the consumer in not paying attention to the printed instructions than to any defect in the meters themselves. It is surprising how some people will disregard or misconstrue the instructions attached to each meter, and try to manipulate the meter in any and every way but the right one. Then, again, bent pennies were a source of great annoyance to us; but I am glad to say this difficulty has been overcome by the makers forming the slot of such a size that a badly bent penny will not enter—at least with any reasonable pressure—and making the case or barrel of the meter large enough so that the penny does not get jammed in it if forced through the slot.

Some of our consumers look upon the meter as a receptacle for all the pieces of tin or other material which may find its way into their possession; and they show an amount of surprise and indignation when called to account for it that is worthier a better cause. Others, again, seem to think that the abstraction of the coin from the meter is their just and due right as part owners of the gas undertaking. An example made of one or two of the latter in the Sheriff Court has had a lasting effect on the morals of their would-be emulators. There are others who use the meter as a savings bank placed handy for their accommodation, by inserting florins instead of pennies. On the approach of the rent day, many are the applications at the gas office for the collector to let them have the balance not due to us to enable them to meet the rent.

Such are a few of the experiences gained during two years' use of the prepayment system; and they are such as to justify our adoption of it.

A scheme to which I look forward with interest is that of supplying and fixing free of charge, in conjunction with these meters, grillers and boiling rings. The extra revenue which will undoubtedly accrue from the introduction of such a scheme will, I am sure, go far towards meeting the extra expenditure involved—much less covering the interest.

Discussion.

Mr. R. S. Carlow (Arbroath) said he thought the members were much indebted to Mr. Wilson for giving them his experience with prepayment meters. At Arbroath, he might say, they did not begin the use of these meters till far on in the year. Their year ended on the 31st of May; and it was after the New Year that they began to use prepayment meters. Since they had adopted them, however, they had put in between 300 and 400 of them. They had placed to capital account upwards of $3,500 as the price of the meters. On the other hand—he made a note of it on the previous day—they had gained from the prepayment meter system, during that period, nearly $900. This was from the month of January; and during that time, too, they were only putting in the meters occasionally. He considered they were making a very great profit from them. He was quite at one with Mr. Wilson that it was the correct thing to do to provide certain consumers with prepayment meters. He had put a great many of them in the houses of consumers who used to burn oil; and, on the other hand, he had substituted them for other meters in the cases of consumers who caused a great deal of trouble—people from whom they did not know when they would get their money. If they carried on as at present, he had no doubt they would make a very good profit indeed for the Corporation. He thought the prepayment meter system should be considered by every gas manager present, because there was no risk whatever with it. There was no deposit needed—their money was there; and they should encourage, as far as possible, gas consumption in every way. As Mr. Wilson had said, they connected gas stoves or boiling rings, or any other form of gas apparatus, with a prepayment meter; and they

were sure of their money. In such towns as Arbroath, where there were a great many mills, they would know that boiling rings, costing about 62 cents, were greatly used in the mornings and at meal hours, and gas was consumed by them to a considerable extent.

Mr. T. W. Ward (Stevenston) said that, from his short experience, and with gas at $1.45 per 1,000 cubic feet, the members would not expect that he had done very much with prepayment meters; but he had heard a great many complaints about the length of time a penny worth of gas lasted. It was only from 2½ to 3 hours. In such cases he had found that the consumers were using No. 7 burners. He took off these burners and put in smaller ones; and he had had no complaints since then. He thought gas managers should, in putting in a prepayment meter, look to the size of the burners to be used.

Mr. J. Ballantyne (Rothesay) said he had a great many prepayment meters in use in Rothesay. He was about the first to introduce them; and he had had some strange experiences with them, especially where people went to Rothesay for the benefit of their health. They might be sitting up reading their favorite novel, and be just coming to an exciting point, when out would go the gas. This annoyed some; while others thought there were burglars in the house. However, they got over these things; and, so far as he knew, prepayment meters were giving great satisfaction. He thought they had about 600 of them. They very often had to go round to these meters between collecting times. Their regular collections were every four months; and frequently they had to go at two months, and take away the money. They often found as much as from $6.25 to $7.50 in the box. He rather thought that, in many cases, if they were to present a bill for $1.87 to these people, they would say they were being robbed; but when they put in from $6.25 to $7.50 themselves, they never said a word. The Corporation had reduced the price of gas since the introduction of these meters; but, instead of changing the setting of the meters, they returned a certain amount to the consumers. When their man called, the consumers, instead of grumbling, were glad to see him, because they knew they would get something back. There was a great future for prepayment meters. They were only beginning to get into some towns. If they were carefully worked—not given to all consumers, but to consumers of other lights, and the like—they would be very profitable. He found he was opening many new accounts; and their income was increasing very rapidly. He considered that towns which were not introducing them were standing in their own light. He did not see why any gas manager should not be able to largely increase, if not actually to double, his consumption, by means of prepayment meters. They certainly cost a little more than others; but they did not give so much trouble now as at first, so that there was nothing to fear. Therefore, in this regard, and taken all through, he thought they had every reason to be thankful that they had prepayment meters at their command, because they gave them the opportunity of having as gas consumers people who would never have been in their ledgers.

The President said he had had a little experience with prepayment meters, as he had about 1,400 of them in use at Coatbridge. He thought he was about the first to adopt these meters in Scotland. He was a little reluctant in doing so at first, as he considered they would not have a class of consumers for them. But he had found they had. Now they had somewhere about 25 per cent. of their meters on the prepayment system. Last year they sold about 7½ million cubic feet of gas through these meters. They had given satisfaction to everyone almost. Prepayment meters were largely used in his place as banks. They had had as many as 12 florins in one. It was no uncommon experience for people to come and ask them to take the money out, as the box was too full. They tried Mr. Ballantyne's method of handing money back; but he was not sure that it was altogether a satisfactory one. It certainly put the collector in a rather curious position, because the money must correspond with the index; and they considered that the better way was to set the indices again. They did this. No doubt it gave a little trouble; but, after all, two men did about 100 meters per day. They now had them all set to give 28 cubic feet of gas for 2 cents. Their ordinary price was 62 cents per 1,000 cubic feet. They had found prepayment meters to be a great benefit. Fourteen or fifteen of the largest iron works in the district had introduced electricity; and they had lost them entirely as consumers of gas. But the extra revenue which had been brought in by prepayment meters had made up for this; and, instead of their having had a decreased consumption of gas in Coatbridge, they had had a slight increase.

Mr. A. Wilson, in reply, said this was his first contribution to their proceedings, and it was certainly very gratifying to think that the members had listened with such patience to one who was a tyro in the matter of reading papers. He found, like Mr. Ward, that people were going to ironmongers and getting large burners, and at first he had a little trouble in this way. Eventually, however, he got consumers to know that they should not use such burners. His Committee, when they introduced prepayment meters, did not see the force of charging poor consumers a higher price for his gas than rich ones; and the consequence was that, the consumers by prepayment meters getting their gas at the same price as the others, while the Committee were paying something like $4.72 for a 2-light dry meter, they lost upon them that year. The profit derived from these meters did not pay the wages of the men who were put on to look after them. They had gone to the other extreme now, and were charging the prepayment consumers 25 cents per 1,000 cubic feet more than consumers by ordinary meters; and they would certainly have to come down from that. Last year they had a balance of $940 more than they should have had. This year, he thought, they would manage to have this amount refunded, in part, to the consumers.

Valuation of Crude Carbolic Acid.

By Mr. Carl E. Smith, in *Am. Jour. Pharmacy.*

The U.S.P. of 1890 characterizes crude carbolic acid as "a liquid consisting of various constituents of coal tar, chiefly cresol and phenol, obtained by fractional distillation." A test for presence of alkali is given, and another, designed to exclude more than 10 per cent. of the less soluble constituents of coal tar.

As might be expected, the commercial supplies of this substance vary considerably in composition and strength, the relative proportions of phenol and the cresols, the percentages of so-called tar oils and of water being particularly subject to variation. Since the cresols have been shown to be about three times more powerful as antiseptics than phenol, it is not a matter of indifference to the consumer whether a product consists chiefly of one or of the others. The non-phenolic constituents of crude carbolic acid, to which the collective name of "tar oils" has been given, may include hydrocarbons, as naphthaline, anthracene, phenathrene, diphenyl, etc., such bases as pyridine, quinoline, aniline, etc., and other substances still undetermined. Some of these compounds mentioned have undoubted antiseptic value, while others are inert. Water is always found, and, if present in larger quantity than 5 per cent., might be looked upon as an adulteration. With ordinary care in the distillation it will not exceed a fraction of 1 per cent., according to the experience of at least one manufacturing firm within the writer's knowledge.

It has been pointed out by Dr. E. R. Squibb (*Ephemeris*, Vol. I., page 328) that the solubility test of the Pharmacopœia is impracticable, as it will reject all samples not composed mainly of crystallizable phenol, excluding cresols and xylenols except in small quantities. A sample containing 96 per cent. of the less soluble phenols never came within 16 per cent. of the requirements. This is applied to the test given in the U.S.P. of 1880, which is practically the same as the present one. This latter reads as follows: "If 50 volumes be thoroughly agitated with 950 volumes of water, the undisolved portion should not exceed 5 volumes, or 10 per cent. by volume of the acid." Dr. Squibb proposed the following modification: "Mix 50 volumes of the sample with 1,000 volumes of water in a vessel of 2,000 volumes capacity and shake actively. Allow to separate, pour off the upper milky fluid, add 500 volumes of water to the residue and again shake vigorously and set aside to separate. Again pour off the watery liquid and transfer the residue to a measuring cylinder. The undissolved residue from crude carbolic acid No. 1 should not be more than 5 volumes, from No. 2 not more than 18 volumes, and from the crude carbolic acid of the market not more than 25 volumes."

H. W. Jayne (*Am. Jour. Pharm.*, 1894, page 119) states that a 60 per cent. acid answered the requirements of the Pharmacopœia, but after distillation, to remove tarry matter and about 11 per cent. of water, showed 30 per cent. insoluble.

It is evident that the solubility test is apt to mislead in several particulars. Intended to exclude inert "tar oils," it excludes the valuable cresols as well. The presence of a large quantity of water, which may reach 20 per cent. or more without possible detection by the official tests, will correspondingly increase the solubility of the acid in water, vitiating the test completely.

A fractional distillation will, of course, give quite serviceable results in approximately indicating the quantities of phenol, cresols, xylenols and water present, and supersaturation with caustic soda solution and extraction with ether will serve as a rough estimation of bases and hydrocarbons. But these methods are too tedious and time-consuming

for the use of the pharmacist, who is in need of methods requiring little time and attention.

Dr. Charles Rice, at whose request the writer took up this subject, suggested that Koppeschaar's bromine solution might possibly be made serviceable here, with proper precaution, to show the proportions of the several phenols by their differences in bromine absorption. To determine with accuracy by this method the proportion of phenol and cresols in mixtures, the following conditions must be fulfilled: The mixture must be either free from all substances other than phenol and the cresols, or they must be present in known quantities and their weight deducted from the weight of the sample taken. The mixture must contain no other substances that bind bromine, or it must contain them in known quantity, in which case the amount of bromine they will take up must be known. The containing substances must not in any other way interfere with the reaction.

To make the method applicable to crude carbolic acid, ready means for determining the non-phenolic bodies present would be required, and it appeared from an examination of the literature on the subject, that simple and satisfactory methods for this purpose were available, but experience with them soon showed them to be wanting in accuracy.

For the estimation of water, it is usually directed to shake a known volume of the acid with a saturated solution of sodium chloride, on the assumption that the diminution in the volume of the acid, after agitation and perfect separation, is equivalent to the volume of water present.

This the writer found far from being the case. A sample of acid, consisting of about equal parts of phenol and the cresols, and conforming to the pharmacopœial requirements, was, on distillation, found to contain about 0.5 per cent. of water. The same sample, on being shaken with an equal volume of the salt solution, should have decreased slightly in volume, but instead, it was found to *increase* 9.5 per cent., with a simultaneous separation of sodium chloride crystals.

When sufficient water was added to the sample to make the mixture contain 5 per cent., and tested in the same manner, it increased 4 per cent. in volume. With 10 per cent. of water it decreased 6.5 per cent., showing two thirds of the water present. With 19.5 per cent., a saturated solution of water in the acid at about 25° C., 15.5 per cent. was indicated. These results show the test to be entirely worthless for detecting or estimating moderate quantities of water, at least in samples containing much phenol. But the error is lessened as the proportion of water increases. Acids, consisting mainly of cresols, give better results.

A sample of this kind, from which 3.9 per cent. of water could be separated by distillation, gained 1.5 per cent. on shaking with salt solution. Saturated with water so as to contain 12.3 per cent., it tested about 8 per cent. Similar results were obtained with commercial "crude cresol." A saturated solution of calcium chloride was tried at the suggestion of Professor Coblentz, but was found to have no advantage over the solution. Separation of the liquids after agitation was also slower, because of the greater density of the solution. Distillation seems to be the only practical method of estimating water, and even this cannot be said to be very exact, since the water that distils over contains considerable quantities of phenol, and the phenol, which comes over with the water and collects on the bottom of the receiver, no doubt contains water. There is also a small loss of water by vaporization.

Another difficulty lies in the estimation of non-phenols other than water. In Allen's "Commercial Organ Analysis," the following method is given for the rough estimation of "tar oils": "Place 10 c c. in a graduated tube, and gradually add 20 c.c. of a 9 per cent. solution of caustic soda (free from alumina). Close and agitate. Neutral oils form a layer above or below, after separating. To make separation more rapid and complete, add a known volume of petroleum spirit." In applying this method to three specimens of varying composition, the writer was unsuccessful. In each case the mixture of acid and soda was perfectly clear and the petroleum spirit, though acquiring a dark color, did not sensibly increase in volume By extracting the alkaline mixtures with ether, the samples yielded respectively about 1, 4 and 5 per cent. of hydrocarbons, bases, etc., after spontaneous evaporation of the ether.

Muter and De Koningh (*Analyst*, Vol. 12, page 191) estimate tar oils by agitating 20 c.c. of the acid with 80 c.c. of 5 per cent. caustic soda solution and 5 to 10 c.c. of benzol. A dark layer which forms under the 100 c.c. mark represents the amount of tar oils in the sample. This was tried with two samples known to contain at least 4 to 5 per cent. of tar oils, but in neither case was a dark layer formed between the alkaline solution and the benzol. With one sample the benzol increased in volume, but an emulsion, at the zone of contact, which did not break up after 24 hours, made a reading impossible. With the other sample the benzol apparently diminished in volume slightly, a small amount remaining permanently in suspension in the aqueous liquid, with a portion of the precipitated impurities from the acid.

Various changes in the details of both procedures were tried without success. It seems likely that at the time they were devised crude carbolic acid was quite different in composition from that now met with. The writer gives preference to the following expedient, but realizes that it is far from accurate, the results probably being always too low: Mix 10 grammes (or 10 c.c.) of the sample with 50 c.c. of 5 per cent. caustic soda solution in a separator. Add to the mixture, after cooling to room temperature, 15 c.c. of ether, and shake actively for a few minutes, then put it aside to separate. Draw off the aqueous liquid and transfer the ethereal solution to a weighed porcelain dish. Extract the alkaline solution with two additional portions of 10 c.c. each of ether, and add these to the contents of the dish. Allow the ether to evaporate spontaneously and weigh the residue, which represents the tar oils in the sample. As nearly all of these are more or less volatile at ordinary temperatures, a considerable proportion of them is probably lost before all ether is vaporized, and since the amounts of the more volatile constituents vary, it is difficult to estimate this loss. In a warm and humid atmosphere, water condenses in the dish during evaporation of the ether, and additional time must be allowed in such cases for the evaporation of this water before weighing, which entails an additional loss of the oils. Under any circumstances the percentage of tar oils obtained by this or other available means must be accepted with considerable reservation.

The uncertainty in the estimation of those constituents of crude carbolic acid not phenols, would render Koppeschaar's bromine method inapplicable to the determination of the ratio of phenol and cresols, even if there were no other objections, but there are two other reasons, which alone would be sufficient to reject it. One is the fact that crude carbolic acid nearly always contains still higher homologues of the phenol series than the cresols, each group of isomers combining with bromine in a different ratio. The other reason is that some of the impurities in the acid also form substitution compounds of bromine under the conditions of the assay, as the writer determined by experiment. The tar oils obtained from two samples by extraction with ether were found in one case to require 6.7 c.c. of decinormal bromine solution for 0.1 gramme of oil, and in the other 6.4 c.c., which is approximately one-tenth as much bromine as is required by the same quantity of pure phenol. One of the samples yielded four times as much to ether as the other, and also in other respects showed great difference in composition, it therefore seems remarkable that there was no greater difference in the bromine absorption of the two ether extracts. It is, however, subject to too much variation to permit the adoption of a constant correction factor.

Two samples of crude carbolic acid were distilled and different fractions of the distillate examined separately. The results are given in the following tables:

Sample I.

Fraction.	Distillate, Per Cent.	C.c. $\frac{N}{10}$ Bromine Solution Required by 0.01 Gramme.
98°–180° 1	Water, 0.5 per ct. Phenol, etc., 0.5 per ct.	
180°–185° (mostly 183°–184°)	34	5.75 white, bulky precipitate.
185°–190°	46	5.6 Do.
190°–195°	13	5.35 brown-yellow, compact precipitate.
195°–200°	4	5.15 Do.
Residue	2	4.65 Do.

The crude acid itself required 5.46 c.c. of decinormal bromine solution for 0.01 gramme of sample. Assuming the proportions of phenol and cresols to be about equal, as indicated by the boiling points, this would be equivalent to approximately 93 per cent. of total phenols. The hydrocarbons, bases, etc., extracted with ether, amounted to 1.05 per cent., and water, separated by distillation, 0.5 per cent. This still leaves 5.5 per cent. unaccounted for. Partial loss of the ether extract through volatilization does not explain this great discrepancy, but it seems probable that crude carbolic acid may contain a considerable quantity of other acids, which ether would not extract from an alkaline solution. Similar, and even greater, discrepanies were noticed in the examination of two other less pure samples.

Sample II.

Fraction.		Distillate, per Cent.	c.c. $\frac{N}{10}$ Bromine Solution Required by 0.01 Gramme
95°–195	3.6	{ Water, 2.8 per ct. Phenols, etc., .8 per ct.	
195°–197.5°.		51	5.15
197.5–200.....		25	4.8
200°–205°.....		14	4.5
Residue.....		6	3.8

The sample was labeled "crude cresol," and had a dark red-brown color. It required 4.68 c.c. of decinormal bromine solution, for 0.01 gramme, which is equivalent to 85 per cent. of cresols, applying the factor for cresols also to other phenols which may be present in small amount. The ether extract was 4.65 per cent., and the water separated by distillation 2.8 per cent., making a total of 92.5 per cent. The remainder is unaccounted for.

A third sample required 4.73 c.c. of the bromine solution for 0.01 gramme, corresponding to about 85 per cent. of cresols, etc. Distillation separated 4 per cent. of water, and 25 per cent. was extracted from the alkaline mixture with ether. As only 1.5 per cent. of phenols passed over below 190° in distilling the water, it was concluded that the sample contained little or no phenol, as the latter boils at 182°, and the cresols between 190° and 200°. This sample also contains 7 per cent. of constituents, that are left undetermined for the present.

It was at first suspected that these discrepancies might have been caused by an error in the strength of the bromine solution. It was therefore re-standardized and found correct. After titration against carefully purified sodium thiosulphate, the solution was used in an assay of the purest phenol obtainable, indicating 98.9, 99.3 and 98.5 per cent. of phenol. The sample melted at 40.5°, the melting point required for absolute phenol being 42.5°, and the result of assay thus being corroborated. Titration of the crude acids being performed under the same conditions, as nearly as possible, insured accuracy of the results.

While it is not yet practicable to accurately determine the quantities of phenol and cresol in the complex mixtures containing them by the bromine method, this method is, nevertheless, in the writer's judgment, better suited than any other single test, to indicate approximately the value of a sample of crude carbolic acid, and it furnishes information that cannot be obtained by the methods in general use, or by a fractional distillation. It may also be safely assumed that its results will be less liable to wrong interpretation. The bromine consumed by a definite amount of the sample and the character of the precipitate formed will give a very fair indication of quality and strength. Tribrom-phenol separates in the assay as a very voluminous, white, floc culent precipitate, leaving the solution perfectly clear. The tri-brom cresols separate imperfectly, a large proportion remaining suspended, forming a liquid of milky appearance. A portion of the precipitate settles to the bottom in form of small brownish yellow globules, which occupy very little space as compared with the precipitate from the same quantity of phenol. It is easy thus to determine whether a sample in hand consists mainly of cresols or of phenol, without determining the boiling points. After making control experiments with mixtures of known quantities of phenol and cresol, it is possible to estimate approxi mately their relative quantities in samples of unknown composition. It was found, however, that the appearance of the precipitate of the one substance is but little changed by the presence of the other in quantities less than fourth.

As the Pharmacopœia places no restriction on the proportions of phenol and the crosols, but merely requires the absence of more than 10 per cent. of the "less soluble constituents of coal tar," it may be assumed that a standard of not less than 90 per cent. of the phenol series was intended, irrespective of the relative quantities of these. The possible presence of large quantities of water was evidently lost sight of, and as this may be legitimately present up to 5 per cent., it would seem that a further allowance to that extent should be made in interpreting the pharmacopœial intentions, making a requirement of at least 85 per cent. of phenols. The quantity of volumetric bromine solution required for a given weight of an 85 per cent. acid must ne cessarily vary with the proportions of the different phenols, as their combining weights for bromine differ, and it is therefore hardly practicable to set an arbitrary limit of the volume of decinormal bromine solution that a definite weight of an 85 per cent. acid shall require. It will be necessary to judge from the character of the precipitate the approximate ratio of phenol and cresols and calculate from the volume of bromine solution consumed their approximate percentages.

The writer recommends to proceed in the assay as follows: Place 1 gramme of the sample into a graduated 100 c.c. flask, nearly fill with water and shake briskly for a few minutes. Then fill to the mark with water and mix thoroughly. Measure 2 c.c. (= 0.02 gramme of the sample) into a glass-stoppered 100 c.c. flask, excluding undissolved matter, by filtration, if necessary. Add 10 c.c. of water, 12 c.c. of decinormal bromine solution and 2 c.c. of hydrochloric acid. Stopper at once securely and shake the mixture occasionally during a half hour. Then add 2 c.c. of potassium iodide test solution in such a manner as to avoid loss of bromine vapor and quickly reinsert the stopper. Shake thoroughly and add decinormal thiosulphate solution until the solution is decolorized. If the sample contains cresols in considerable quantity, the solution will become yellow again after standing a short time, probably due to the gradual breaking up of an additional product of tribrom-cresol and bromine or iodine. This may be hastened by active shaking after each addition of thiosulphate to the decolorizing point, and must be continued until the solution remains colorless after prolonged shaking. The number of cubic centimers required, deducted from 12, gives the number of cubic centimeters of decinormal bromine solution consumed by 0.02 gramme of the sample.

The following short table will assist in calculating the result of the titration. It gives the volume of decinormal bromine solution required for 0.02 gramme of samples containing 85 per cent. of phenol and cresols, in different ratios, and 10 per cent. of tar oils, the bromine absorbed by these being included:

Chiefly phenol	11.0	c.c.
Phenol, $\frac{3}{4}$; cresol, $\frac{1}{4}$.....	10.65	"
" $\frac{1}{2}$; " $\frac{1}{2}$.....	10.3	"
" $\frac{1}{4}$; " $\frac{3}{4}$.....	9.95	"
Chiefly cresol	9.6	"

The quantity of the still higher homologues of the phenols likely to be present is usually too small to make it necessary to consider them in the calculations for such rough estimations.

An example will best illustrate the calculation of results. The appearance of the precipitate indicates phenol and cresols to be present in about equal quantities, and 10.7 c.c. of decinormal bromine solution is required. According to the table, an 85 per cent. acid would have required 10.3 c.c., so a simple proportion is all that is required.

$$10.3 : 10.7 : : 85 : x ; x = 88 \text{ per cent.}$$

This quantitative bromine test as a substitute for the present pharmacopœial solubility test, and the test for alkali are all that is required to arrive at the value of a sample for disinfecting purposes. No other information of any value can be obtained short of fractional distillation.

The Coe Bench Drill.

The St. Louis (Mo.) Machine Drill Company is putting on the market a handy bench drill for drilling holes up to ½-inch. The spindle is prolonged and its upper portion carries a spring, as shown. On the upper end rests a lever arm, which is connected by a link with the frame. A

very sensitive arrangement is thus provided. The tool is designed to be run from a shaft either above or below the drill by changing the position of the idler pulleys. The spindles are furnished straight or turned to Morse taper, or are fitted with suitable chucks. The main dimensions are: Distance from center of spindle to frame, 4 inches; greatest distance from spindle to table, 5 inches; size of spindle, ¾-inch; vertical movement of spindle, 3 inches; vertical movement of table, 2½ inches; diameter of table, 5 inches; drill capacity, 0 to ¼ inch; height of drill, 20 inches; weight of drill, 30 pounds.

Ellin's Soldering Iron.

The illustration shows a new form of soldering iron, which has (and justly it seems to us) found great favor in the English market. It will be seen, from the illustration, that the copper bit can be set at any angle to the handle, the purpose being to render the tool convenient for electricians and men working in awkward corners. The shank is

made of thin metal, and is provided with a passage through which air will circulate to carry off the heat and prevent it reaching the hand of the workman. The whole device is very neat, and should recommend itself to users. The manufacturer of this instrument is Mr. Thomas R. Ellin, of Sheffield, England.

On the Limits of Inflammability of Combustible Gases.

In a late number of *Comptes Rendus*, MM. H. Le Chatelier and O. Boudouard, in discussing the matter named in the heading, say:

The inflammability of gaseous mixtures is a most complex problem—it must of necessity depend on most varying conditions, such as the heat of combustion, the speed of combination, etc. The work already done in this direction—unfortunately too little—has not formulated any precise relationships between the different phenomena which come into play. If we wish to sufficiently multiply the number of the experiments we must not confine ourselves to the combustible gases only, but we must include combustible vapors, which comprise a large number of compounds met with in organic chemistry.

To determine the limit of inflammability of a vapor—that is to say, the smallest quantity of this vapor which, when mixed with a definite quantity of air, is inflammable—we must not follow the same method as in the case of a gas. We have, in the case of very volatile liquids, such as ether, sulphide of carbon, and benzene, introduced successively known weights of these bodies into a flask of 2 liters capacity, previously full of air. A stirring apparatus, already in the flask, served to assist the evaporation, and also to render the mixture homogeneous.

The experiment was repeated until we obtained two separate weights, varying by at least 10 per cent., the weakest of which gave an uninflammable mixture and the strongest an inflammable one. The mean of these two numbers was taken as the limit of inflammability, which is thus within 5 per cent. of the true figure.

In the case of slightly volatile bodies, such as the alcohols, essence of turpentine or naphthaline, we should place the body in a 500 c.c. flask, kept at a constant temperature. A thermometer, to which a stirrer is attached, accelerates the saturation of the air. The temperature, corresponding to the limit of inflammability, has been determined to within 1 degree. To estimate the quantity of vapor existing in the mixture at this temperature, we passed a known volume of air (2 liters) through a small tube containing pumice stone saturated with the liquid and kept at the same temperature. The loss of weight gives the quantity of liquid which must be vaporized in order to furnish a volume of the mixture equal to 2 liters augmented by the volume of this vapor.

This method is, however, less exact than the preceding one, for two reasons: On the one hand, the rapid variations in the vapor tension due to alterations of temperature; and on the other hand, by reason of the difficulty of perfectly saturating a given mass of air. The experimental errors by this second method may be at least twice as great as those by the first.

In the table in which the results are collated, the letters at the heads of the columns have the following significance:

t. Saturation temperature of the air.
p. Weight of vapor, per liter of the mixture, at a temperature of 15°.
v. Volume of vapor in 100 volumes of the mixture.
o. Volume of oxygen necessary for the complete combustion of the vapor.
q. Quality of heat given off by the combustion of 1 molecular volume of the mixture—that is to say, 23.5 liters at 15°.

Compounds Experimented on.	*t.* Degrees.	*p.* Grammes.	*v.*	*o.*	*q.*
Hydrogen	—	—	10	5	6 9
Carbonic oxide	—	—	16	8	11
Sulphide of carbon	—	0.063	1.94	5.9	4.9
Coal gas	—	—	8.1	9	10
Petroleum ether	—	0.045	—	—	13
Essence of petroleum	—	0.051	—	—	13
Petroleum oil	46.5	0.057	—	—	14.5
Methane	—	—	6	12	12.9
Pentane	—	0.034	1.1	9	9.5
Hexane	—	0.048	1.3	12 7	13.1
Heptane	—	0.047	1.1	12,3	12 9
Octane	—	0.049	1.0	12 6	13.1
Nonane	12	0.045	0.83	11.6	12.1
Acetylene	—	—	2.8	7	8 9
Amylene	—	0.046	1.6	11.9	12.8
Benzene	—	0.044	1.5	11	11.6
Toluene	—	0.049	1.3	11.4	11.8
Turpentine	30.5	0.042	0.73	10.2	10.9
Naphthaline	69	—	—	—	—
Acetone	—	0 073	2.9	11.6	12.7
Methyl alcohol	8	0.081	6	9	10.8
Ethyl "	13.5	0.060	3.07	9.2	10.3
Propyl "	25	0.065	2.55	11.5	12.5
Isopropyl "	17	0.068	2.65	12	12.7
Isobutylic "	27.5	0.053	1.68	10.1	10.8
Allylic "	25	0.074	3.04	12.5	13.4
Amylic "	38	0.045	1.19	9.0	9.5
Acetic acid	36	0.103	4.05	8.1	8.9
Ethylic oxide	—	0.060	1.9	11.7	12.5
Ethylic acetate	—	0.087	2.3	11.7	12.3
Nitrate of ethyl	—	0.145	3.8	—	12.2

Putting aside hydrogen and sulphide of carbon, of which the inflammabilities are very great, it will be noticed that for all the other bodies examined the heat of combustion of the mixture taken on 1 molecular volume is comprised between 9 cals. and 13 cals., and that for most of them is between 12 cals. and 13 cals., numbers which do not vary more than the possible errors of experiment. We are therefore warranted in stating, in a general manner, that the limit of inflammability of the greater part of the carbon compounds corresponds to a heat of combustion of about 12.5 cals. The same table shows that the amount of oxygen consumed in the combination of these mixtures also varies very slightly from 11.5 of the total volume of the mixture.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE attempt to organize an opposition gas and electric light company at San Bernardino, Cal., was a complete failure. It was proposed to form a company with a capital stock of $50,000, in 2,000 shares of $25 each, the stock to be taken by residents of the place. The canvassers declared that the proposed company would sell gas and electric lights at rates about 33⅓ per cent. less than those charged by the existing Company, representing that at such rates it had been ascertained, did the newcomer succeed in no more than dividing the lighting business of the town, that 6 per cent. per annum could be gained on the investment. The result of the canvassing was that only $12,000 was subscribed, and the project was discontinued.

AT a recent meeting of the Directors of the Evansville (Ind.) Gas and Electric Light Company, convened to take appropriate action over the death of Mr. Samuel Bayard, the following minutes were adopted:

"Samuel Bayard is dead, and by his death the Evansville Gas and Electric Light Company loses a faithful friend and adviser. He has been a director in, and Treasurer of the Company, since its organization, and for its prosperity was ever active and earnest. His wise counsels will be missed by the Directors and officers of this Company. It is proper that this Board should give expression to its sorrow; therefore, be it

"*Resolved*, That the Evansville Gas and Electric Light Company mourns the loss of one who was always in his associations the very soul of honor, faithful and true to every trust, kind and generous to his friends; charitable and sympathetic, no worthy needy one ever applied for help to him in vain.

"To the afflicted wife we extend our sincere sympathy, and direct that a copy of the foregoing be handed her by our Secretary, and that it be recorded in the records of this Company and given to the press of the city for publication.—JAS. H. FOSTER, Secy."

AT the annual meeting of the Concord (N. H.) Gas Light Company the following Directors were elected: Lyman D. Stevens, John Kimball, Henry McFarland, F. A. Stillings, John P. George, Benjamin C. White and John M. Mitchell.

THE failure of Mr. Galen C. Moses, of Bath, Me., will in no manner affect the affairs of the Athol (Mass.) Gas and Electric Company, of which corporation Mr. Moses was President.

THE Universal Manufacturing Company has been organized at Portland, Me., for the purpose of manufacturing and dealing in gas valves. It is capitalized in $10,000, and its officers are: President, William J. Ross, of Chelsea, Mass.; Treasurer, Edward L. Rand, of Jamaica Plain, Mass.

THE Directors of the Southwestern Gas, Electric and Street Railway Association met early this month in the [illegible]nger Hotel, San Antonio, Tex. Those present included President Carl F. Drake, of Austin, Tex.; Second Vice-President L. Dysterod, of Monterey, Mexico; Secretary E. L. Wells, Jr., of Marshall, Tex.; Treasurer F. Fries, of San Antonio; Third Vice-President, W. H. Weiss, of San Antonio, and Messrs. F. E. Scoville and W. E. Holmes, of Austin, Tex., and L. T. Fuller, of Calvert, Tex. Messrs. T. D. Miller, of Dallas, Tex., J. F. Strickland, of Waxahachie, and McGregor, of Houston, Tex., were represented by proxy. The purpose of the meeting was to select and assign the subjects for papers to be discussed at the next annual meeting of the Association, to be held in Austin, Tex., next April, and to discuss the action of the special committee appointed at the last meeting to revise the constitution and by-laws. Our correspondent, in further mention of the special session at San Antonio, says: "In an interview with Secretary Wells, that official gave expression to the belief that the Association's purposes and objects were of a nature calculated to induce every Company engaged in gas or electric lighting, or street railway work in Texas, Louisiana, Arkansas, New Mexico, Oklahoma and Indian Territory and Mexico, to take membership in it. The question of entertainment at the next meeting was considered, and a special committee was appointed to plan therefor. A committee was also appointed to confer with the insurance companies with the object of attempting to secure a reduction in the current rates. Other routine business was transacted, after which the Directors adjourned, subject to reconvention at the call of the chairman.—F."

THE Borough Council, of Darby, Pa., has advertised for new tenders for the public lighting of that place, the tenders to contain figures based on contracts for one year and for five years, the work to be commenced on December 1, 1898. The existing contract would have expired by limitation October 1, but the Council authorized the present contractors (the Darby Gas Company and the Pennsylvania Globe Gas Light Company) to perform the lighting up to December 1, at the rates now charged.

AT a recent meeting of the Beverly (Mass.) Common Council, Mr. Haskell introduced an order to the effect. "That it is expedient for the city to exercise the authority conferred by Section I., Chapter 370, of the Acts of 1898, which enables cities and towns to manufacture and distribute gas and electricity, and that the provisions of said section are hereby accepted. That in addition thereto the City Council hereby decides that the city will construct, purchase, lease or establish one or more plants for the manufacture and distribution of gas and electricity for furnishing light, heat and power for municipal use, and for the use of such of its inhabitants as may pay for the same. And it is further ordered that immediately upon the passage of this order the Mayor shall make a written request upon the Beverly Gas and Electric Company to make and file with the City Clerk, within 30 days, a detailed statement of all the property and plant of said Company then existing, which said Company may propose to sell to the city with the terms of sale proposed therefor in case the city shall complete the decision to establish such plant or plants." The order was referred to the Committee on Rules for consideration and report.

THE ordinance under which it is proposed to operate the Milford (Pa.) Gas Company is very favorable to the Company. In fact the Company may run its pipes anywhere in the borough, provided it exercises "due diligence and expedition" on the work, and that it shall be liable at all times for any and all damages for any injury occasioned by reason of the laying, maintaining and repairing of its said mains and pipes. Mr. George A. Swepeniser, Chief Burgess of the Borough, approved the ordinance on the 6th inst.

CERTAIN speculators are endeavoring to secure an ordinance for an opposition gas plant at Wichita, Kas. The projectors of the scheme declare that they will sell good gas at $1 per 1,000, which figure to our minds would represent the bare cost of making gas in the place named.

THE voters of Des Moines, Iowa, have negatived the proposition to purchase the plant of the local water Company, for operation on public account.

THE current annual meeting of the Malden and Melrose (Mass.) Gas Company was of sufficient interest to cause the representation of 2,220 shares out of the 2,350 shares in the Company. The officers chosen were: Directors, Frank E. Chandler, Seth E. Benson, Roswell R. Robinson, Edward O. Holmes, Vinton W. Mason, Eugene N. Foss and Edwin A. Hildreth; President, Frank E. Chandler; Clerk and Treasurer, Vinton W. Mason.

JUDGE WILLSON, of Common Pleas Court, No. 4, Philadelphia, has handed down a decision in the equity proceeding brought by Mr. Wilbur F. Rose against Mr. Charles Barclay and the Camden (N. J.) Gas Light Company. The bill was to compel Mr. Barclay to transfer to Mr. Rose certain shares of stock of the Gas Light Company alleged to represent a division of the vested earnings of the corporation among the stockholders. On July 6, 1893, Mr. Rose purchased from Mr. Barclay 30 shares of the stock for $4,500. On the 5th of the preceding June the Board of Directors of the Company had passed a resolution that an increase of the stock be divided among the stockholders who should appear as such on the books of the Company on July 1 following, in proportion to the shares of stock then standing in their respective names. The complaint averred that the sale, covered not only the shares transferred by the sale, but 30 additional shares to which Mr. Barclay became entitled by the above mentioned action of the Board of Directors. This allegation was denied by the defendant, and Judge Willson decided that there was no evidence sufficient to overcome the denial. The Court prepared a decree directing that the bill be dismissed with costs, but without prejudice to the right of Mr. Rose, if such, existed, to rescind the contract by any proper proceeding. After the case had reached this point, an amendment to the bill was filed dealing with the question as to whether or not the complainant was entitled to a decree rescinding the contract of sale. Judge Willson says there was no fraud or intention to take advantage of another, but that the parties honestly dealt concerning an item of property as to which each had equal opportunities of information, and the transaction was closed upon a basis which subsequently appeared to have been different in fact from what either party expected or intended. That it appeared to be a case of mutual mistake of fact such as would be followed by a recision of the contract. The adjudication, therefore, concludes by saying that Mr. Rose is entitled to a recision of the contract, that he shall return the stock originally transferred, with dividends, etc., to Mr. Barclay, who shall return the amount of the purchase price, with interest.

JUDGE DUNNE has dismissed the suit instituted by James Duane Livingston, under which plaintiff asked for the dissolution of the consolidation of the local Chicago Gas Companies, under which was formed the present Peoples Gas Light and Coke Company, of Chicago, on the ground that such consolidation had been perfected in contravention of the statutes. He also asked for the appointment of a receiver to take charge of the properties of the Companies that had entered into the consolidation, etc. Complainant sued as a holder of $15,000 bonds in three of the merged Companies. Judge Dunne's decision is very interesting, and it completely upholds the constitutionality of the Act of the Legislature authorizing or permitting the consolidation.

ON the petition of the Farmers Loan and Trust Company, of New York, as Trustee for the bondholders, the Paducah (Ky.) Gas Light Company has been placed in the hands of a receiver. The Company has defaulted in its interest payments on a first mortgage bond issue of $100,000. The proceeding was taken before Judge Barr, of the District Court, Kentucky, who, having examined the papers, granted the petition and named Mr. Sanders A. Foster to the receivership. His bond was placed at $10,000, and he is now in charge of the property.

ADVICES from Rochester, N. Y., are to the effect that negotiations looking to a change in the ownership of the Tonawanda (N. Y.) Gas Light Company are underway.

IT is reported that Charles Gregory has applied to the Council of Fulton, Ky., for the right to operate a gas works there. Fulton is located at the junction of the Paducah and Memphis and the New Orleans, St. Louis and Chicago Railroads, at a point 50 miles southwest of Paducah. It is a small place, its population not exceeding 2,000.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,

PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,

EDITORS.

CHAS. E. SANDERSON,

MANAGER.

MONDAY, SEPT. 19, 1898.

The Market for Gas Securities.

The feature of the week in the trading in city gas shares was a sharp decline in Consolidated, which sold down to 180 and a fraction, from which point it slowly recovered to 182. The opening to-day (Friday) was reported at 182 to 183. The canvassing for trade between the New Amsterdam and Consolidated Companies still goes on, but as said last week the contest is not being fought with vigor. We believe that the ending of this wretched, unbusiness like squabble is close at hand. New Amsterdam common is notably weaker, while Mutual remains steady. The Standard shares are also well held.

Brooklyn Union is 124 to 126; Peoples, of Chicago, is 106⅝ to 106½; Baltimore Consolidated is weaker, at 64 to 64¼; Detroit gas has crossed the 65 mark, and Bay State is 3⅛ to 3¼. A pronounced outcome respecting the legal mess in which Bay State wallows may be looked for prior to the 15th prox.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

SEPT. 19.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	182	183
Cental Union, Bonds, 5's	3,000,000	1,000	103¾	104
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	327	335
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	27¾	28
Preferred	10,000,000	100	69	70
Bonds, 5's	11,000,000	1,000	99	100½
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000		107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	139	141
Preferred	5,000,000	100	157	165
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	124	126
" " Bonds (5's)	15 000,000	1,000	115	115½
Bay State	50,000,000	50	3⅛	3¼
" Income Bonds	2.000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	..
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	23	24
" " Bonds, 5's	5,250,000	1,000	95½	96
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	89	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers. Jersey City	2,000,000	100	78	85
" Bonds	600,000	1,000	101½	103½
Cincinnati G. & C. Co.	8,500,000	100	206	206¼
Consumers, Toronto	1,000,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	
Consolidated, Baltimore	11,000,000	100	..	64¼
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,500,000	50	65	65¼
" Prior Lien 5's	4,538,000	1,000	94¼	94½
Detroit Gas Co., 5's	428,000	1,000	..	..
" Inc. 5's	34,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co	230,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	49⅞	50
Preferred	2,500,000	100	93	94
Bonds	10,000,000	1,000	105	105¼
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	52	53
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	106⅜	106½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	85⅝	86
St. Paul Gas Light Co	1,500,000	100	49	51
1st Mortgage 6's	650,000	1,000	84	87
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	17	18
Bonds	1,500,000	1,000	94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,556,000	.	101¾	102½
Wilmington, Del.	550,000		204	206

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	443
Fred. Bredel, Milwaukee, Wis.	430
Geo. R. Rowland, New York City	443
The Western Gas Construction Co., Fort Wayne, Ind.	432
Humphreys & Glasgow, New York City	436
American Gas Co., Phila., Pa.	430
David Leavitt Hough, New York City	445
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	443
Baxter & Lynn, Detroit, Mich.	426

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	441
United Gas Improvement Co., Phila., Pa.	435
Burdett Loomis, Hartford, Conn.	442
National Gas and Water Co., Chicago, Ills.	437
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	443
The Western Gas Construction Co., Fort Wayne, Ind.	432
Humphreys & Glasgow, New York City	436

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	444
Continental Iron Works, Brooklyn, N. Y.	442
Deily & Fowler, Phila., Pa.	444
Kerr Murray Mfg. Co., Fort Wayne, Ind	440
Stacey Mfg. Co., Cincinnati, Ohio	443
Bartlett, Hayward & Co., Baltimore, Md.	441
Davis and Farnum Mfg. Co., Waltham, Mass.	440
R. D. Wood & Co., Phila., Pa.	442
Isbell-Porter Company, New York City	442
Fred. Bredel, Milwaukee, Wis.	430
United Gas Improvement Co., Phila., Pa.	435
Berlin Iron Bridge Co., East Berlin, Conn	429
National Gas and Water Co., Chicago, Ills.	437
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	443
The Western Gas Construction Co., Fort Wayne, Ind.	432
Humphreys & Glasgow, New York City	436
Gas Engineering Co., Pittsburgh, Pa.	440
American Gas Co., Phila., Pa.	430
Logan Iron Works, Brooklyn, N. Y.	444
Riter-Conley Co., Pittsburgh, Pa.	436
Baxter & Lynn, Detroit, Mich.	426

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	443
R. D. Wood & Co., Phila., Pa.	442
James R. Floyd's Sons, New York City	444
Continental Iron Works, Brooklyn, N. Y.	442
Gas Engineering Co., Pittsburgh, Pa.	440
Logan Iron Works, Brooklyn, N. Y.	444
Riter-Conley Co., Pittsburgh, Pa.	436

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	443
R. D. Wood & Co., Phila., Pa.	442

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	427
G. Shepard Page's Sons, New York City	443
Gas Engineering Co., Pittsburgh, Pa.	440

GAS METERS.

John J. Griffin & Co., Phila., Pa.	448
American Meter Co., New York and Philadelphia	447
Helme & McIlhenny, Phila., Pa.	447
D. McDonald & Co., Albany, N.Y.	445
Nathaniel Tufts Meter Co., Boston, Mass.	446
Maryland Meter and Mfg. Co., Baltimore, Md.	446
Metric Metal Co., Erie, Pa	446
Keystone Meter Co., Royersford, Pa.	446
Detroit Meter Company, Detroit, Mich.	447

PREPAYMENT METERS.

American Meter Co.. New York and Philadelphia	447
John J. Griffin & Co., Phila., Pa.	448
D. McDonald & Co., Albany, N. Y.	445
Helme & McIlhenny, Phila., Pa.	447

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	445
M. J. Drummond & Co., New York City	445
R. D. Wood & Co., Phila., Pa.	442
Warren Foundry and Machine Co., New York City	445
Donaldson Iron Co., Emaus, Pa.	445
Utica Pipe Foundry Co., Utica, N. Y.	445

PIPE CUTTERS.

The Anderson Pipe Cutter Co., East Boston, Mass.	429

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	437

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	439
Perkins & Co., New York City	438
Despard Gas Coal Co., Baltimore, Md.	439
Westmoreland Coal Co., Phila., Pa.	429
Berwind-White Coal Mining Co., New York and Phila.	458
W. D. Althouse & Co., Phila., Pa.	439

CANNEL COALS.

Perkins & Co., New York City	438
W. D. Althouse & Co., Phila., Pa.	439
Greasy Creek Cannel Coal & Tramway Co., Chicago, Ills.	427

GAS ENRICHERS.

Standard Oil Co., New York City	439
The Sun Oil Co., Pittsburgh, Pa.	439

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	439

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 427

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 437
Isbell-Porter Co., New York City..... 442
R. D. Wood & Co., Phila., Pa..... 442
Wm M. Crane Co., New York City 427

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y..... 428

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J..... 428
B. Kreischer & Sons, New York City..... 428
Adam Weber, New York City..... 428
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 428
Cyrus Borgner, Phila., Pa..... 428
James Gardner, Jr., Pittsburgh, Pa..... 428
Henry Maurer & Son, New York City..... 428
Baltimore Retort and Firebrick Co., Baltimore, Md..... 428
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 428
Brooklyn Firebrick Works, Brooklyn, N. Y..... 428
F. Behrend, New York City..... 429

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md..... 441
Fred. Bredel, Milwaukee, Wis..... 430
J. H. Gautier & Co., Jersey City, N. J..... 428
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 428
Adam Weber New York City..... 428

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City..... 442
Continental Iron Works, Brooklyn, N.Y..... 442
G. Shepard Page's Sons, New York City..... 443
Logan Iron Works, Brooklyn, N. Y..... 444
R. D. Wood & Co., Phila., Pa..... 442

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa..... 434
Victor Incandescent Company, New York City..... 426

MICA GOODS.

The Mica Mfg. Co., New York City..... 427

BURNERS.

C. A. Gefrorer, Phila., Pa..... 442
Wm. M. Crane Co., New York City. 427

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 426

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila..... 436

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 437
Greenpoint Chemical Works, Brooklyn, N.Y..... 437
Gas Purification and Chemical Co., Ltd., London..... 437

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 431
Isbell-Porter Company, New York City..... 442
Connelly Iron Sponge and Governor Co., New York City 437

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 432
Chapman Valve Manufacturing Co., Boston, Mass..... 432
R. D. Wood & Co., Phila., Pa..... 442
Continental Iron Works, Brooklyn, N. Y..... 442
The P. H. & F. M. Roots Co., Connersville, Ind..... 431
Isbell-Porter Co., New York City..... 442
The Western Gas Construction Co., Fort Wayne Ind.... 432

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 443

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa..... 412
Backus Water Motor Co., Newark, N. J..... 390

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City..... 429
W. G. & G. Greenfield, East Newark, N. J..... 390

PURIFIER SCREENS.

John Cabot, New York City..... 427

GAS STOVES.

American Meter Co., New York and Philadelphia..... 438
Maryland Meter and Manufacturing Co., Baltimore, Md. 446
Keystone Meter Co., Royersford, Pa..... 446
Wm. M. Crane Co., New York City..... 427

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y 432

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO., DREXEL BUILDING, PHILA., Sept. 7, 1898.

The Directors have this day declared a dividend of One Dollar per share, payable September 19, 1898, to stockholders of record at the close of business September 12th. Checks will be mailed.

1214-2 EDWARD C. LEE, Treas.

WANTED,

A Hustling Superintendent.

One qualified in manufacture and distribution of coal gas, also office duties. Answer at once, giving age, references, etc. Population, 12,000. Address

CLARKSVILLE GAS LT. CO.,
1215-1 Clarksville, Tenn.

WANTED,

A Position with a Gas Company,

By a young man thoroughly competent in the office and experienced and successful in selling stoves and getting new business generally. Good recommendation from present employers and good reason for wanting a change.

1212-4 Address "J. G. M.," care this Journal.

PHOTOMETER FOR SALE.

Hartley-Bunsen Universal Photometer

In fine condition. Fitted for measuring both gas and electric lights. Will be sold cheap. Address

RALPH VOSE,
1215-1 25 Sunnyside Street, Hyde Park, Mass.

FOR SALE,

Complete Set of Castings for a Coal Gas Retort House of Twenty Benches of Six Retorts to the Bench. Most of it has never been in use. Also,

Two Sets of Flannery Water Gas Apparatus.

Apply to the CONSOLIDATED GAS COMPANY,
1214-4 Pittsburg, Pa.

DR. MOSS is open to engage with responsible firm as representative, or charge of works. Will advise on all difficulties met with in the manufacture and distribution of Coal, Oil or Water Gas. Terms reasonable.

Address
DR. MOSS,
1178-tf Care this Journal.

Position Wanted.

A young, active engineer wants the management of a gas property, or a position under an older man at a large works.

1184-tf "M. L. B.," care this Journal.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind

FOR SALE.

Twelve or Sixteen Bredel Mouthpieces, in Good Shape.

Write THE DALLAS GAS AND FUEL CO.,
1208-9 Dallas, Texas.

FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.
Two Coolers, or Air Condensers, each of 150 000 cubic feet capacity.
Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tubes, 10 ft. 6 in. long.
D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.
Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.
S-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

KEY CITY GAS CO
1119-tf Dubuque, Iowa.

THE MACHINE THAT KNITS
INCANDESCENT GAS LIGHT
Mantle Fabric
AUTOMATICALLY IS MADE BY
LAMB MFG. CO.
CHICOPEE FALLS, MASS.

CUT AND PRICES FURNISHED ON APPLICATION.

BAXTER & LYNN.

GAS ENGINEERING AND CONSTRUCTION.

Examination Made of Gas Properties.
Values Ascertained, and Advice as to Management.

OFFICE: WAYNE COUNTY BANK BUILDING, DETROIT, MICH.

GAS EXPERTS INDORSE
Steward's
SPECIAL BURNERS.

Now in use by THE LARGEST Gas Companies in AMERICA.

The D. M. Steward Mfg. Co.,

CHATTANOOGA, Tenn. AND 107 CHAMBERS ST., New York City.

"VICTOR" Regenerative Incandescent Gas Lamps and Mantles

No Air Shutter, therefore no Smoked Mantles. Hot Air taken from Chimney. Impossible to snap back. "VICTOR" MANTLES are the strongest and most durable on the Market.

Address for full particulars and Illustrated Catalogue,

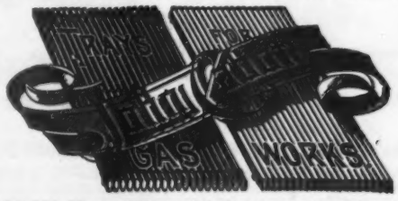
VICTOR INCANDESCENT CO., 171-173 6th Ave., N.Y. City.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

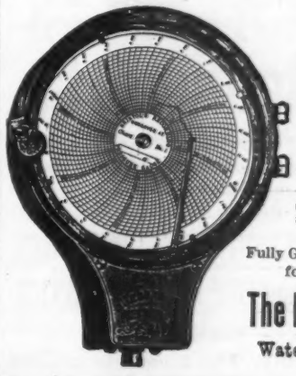
Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

Special Trays for Iron Sponge or Oxide of Iron,
CHURCH'S TRAYS a Specialty.
Reversible, Strongest, Most Durable, Most Easily Repaired.



553-557 West Thirty-third Street, New York.
We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET.
Send for Circulars.



BRISTOL'S RECORDING
PRESSURE GAUGE.
For continuous records of
Street Gas Pressure
Simple in Construction, Accurate in Operation
Low in Price.
Fully Guaranteed. Send for Circulars.
The Bristol Co.,
Waterbury, Conn.

Our Mica Chimneys

Etched Chimneys to Order.

For Welsbach Lights
ARE THE
BEST IN THE WORLD.
Get Catalog and Discounts.
The MICA MFG. CO
Micasmiths,
88 Fulton Street,
N. Y. City.

KENTUCKY CANNEL COAL, FOR GAS AND DOMESTIC USE.

GEO. R. HISLOP, F.C.S., F.R.S.S.A., Gas Engineer of Paisley, Scotland, says in his analysis: "This is a remarkably rich Cannel Coal, yielding illuminating matter per ton equivalent to 1,945 lbs. of sperm candles."
This coal mined and shipped in box cars. Write for sample car and delivered price.

The Greasy Creek Cannel Coal and Tramway Co.,
58 and 60 WALDO PLACE, CHICAGO, ILL.

WILLIAM M. CRANE COMPANY,

Office and Showrooms: 1131 and 1133 BROADWAY.

Gas Appliances for every purpose, and all up to date.

GAS HEATING STOVES,
GAS FIRES,
GAS RADIATORS,
GAS LOGS,
GAS CANDY STOVES,
GAS GRIDDLES,
GAS FURNACES,
GAS IRONS,
GAS SIGNS,
GAS WATER HEATERS,
GAS KILNS,
GAS LAUNDRY STOVES,
GAS OVENS,
GAS PLATE WARMERS,
GAS OYSTER STEWERS,
GAS CONTROLLERS,
GAS BROILERS,

GAS RANGES,
GAS SOLDERING STOVES,
GAS STEAM TABLES,
GAS CREMATORIES,
BRAY BURNERS,
GAS BURNERS,
GAS TIPS,
GAS SELF-LIGHTING BURNERS,
BY-PASSES,
GAS FITTINGS,
METER COCKS,
SERVICE COCKS,
WAX TAPERS,
GOOSE NECKS,
SOCKETS, ETC.
TUBING,
IRON CASTINGS.

FOUNDRY: Peekskill, N. Y.
OFFICE: 1131-1133 Broadway, New York.
FACTORY: 447 to 453 W. 14th St.

NOW READY.

THE SIXTH (AND CENTENARY) EDITION
— OF THE —
Handbook for Gas Engineers and Managers.
By THOMAS NEWBIGGING, M. Inst. C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

PRICE, - - $6.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, N. Y. City.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY. Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

E. D. WHITE, President. A. H. GUTKES, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St., Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Exclusive Agents for

The Mitchell Half-Depth Regenerative Furnace.

This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

Proprietors of the Coze System of Inclined Retorts.

Office: 901 Pine St., **St. Louis, Mo.**

ESTABLISHED IN 1845.

B. KREISCHER & SONS,

Office, 119 E. 23d St., New York.

Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works,
LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR.,

Successor to WILLIAM GARDNER & SON

Hamilton Building, Fifth Avenue,
PITTSBURGH, PA. P. O. Box 373

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

PRICE LIST.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD & CO.,

N. 3d & Prospect Avs., Mt. Vernon, N.Y.

Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec'y
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE
RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 16x16x2.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

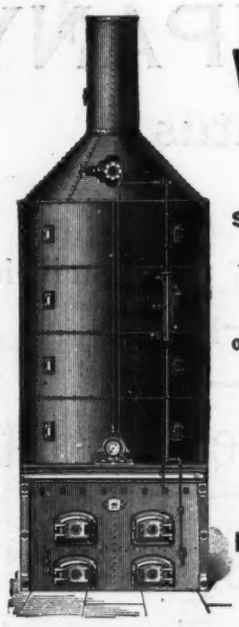
Sole Agents for New England States.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00 A. M. CALLENDER & CO., 32 Pine Street, N. Y. City



HIGH-PRESSURE
WATER-TUBE BOILERS.

THE HAZELTON OR PORCUPINE BOILER
IN 50 to 500 H. P. UNITS.

SINGLE BOILERS OR COMPACT BATTERIES.
GREAT SAVING OF FLOOR SPACE
AND FUEL.

LARGE-SIZE BOILERS IN STOCK.

Our new book, "The Generation of Power," will be mailed on request.

THE HAZELTON BOILER CO.
Sole Proprietors and Manufacturers.
ALSO BUILDERS OF
Stacks, Tanks and Miscellaneous Metal Work.
GENERAL OFFICE:
No. 716 E. 13th ST., New York, U.S.A.

Cable Address, "Paila," New York.
Telephone Call, 1229-18th Street, New York.

Iron Roof For Sale.

Width of building, 155 feet out to out, divided into a center span 66 feet, with a wing on each side 43 feet 6 inches; total length of the building, 350 feet. This building is designed with brick side and gable walls, with iron roof trusses and iron supporting columns. Originally built for an Iron Foundry, but, owing to the failure of the purchaser, is now offered for sale at a bargain. Is admirably adapted for a Foundry for light or heavy castings, Machine Shop, Car Barn, or for any other general manufacturing purposes. We guarantee the ironwork as good as new, the building never having been used.

Berlin Iron Bridge Company,
EAST BERLIN, CONN.

F. BEHREND
SOLE IMPORTER OF THE CELEBRATED
German (Stettin-Didier) Clay Gas Retorts,
BLOCKS, TILES, FIREBRICKS, FIRE CEMENT
Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip, New York.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.

Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
THE ANDERSON PIPE CUTTER COMPANY, Manufacturers,
163 Liverpool st., E. Boston, Mass
N. Y. Office, 135 Greenwich St
C. H. TUCKER, JR., Manager.
WALDO BROS.,
102 Milk Street, Boston, Mass

The Gas Engineer's Laboratory Handbook.
BY JOHN HORNBY, F.I.C. Price, $2.50.
A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

Gas Investments in California.

Nowhere else on this continent does such opportunity exist for profitable gas investment as on the Pacific Coast, since the perfection of the new LOWE Process for using the heavy crude California oils (of which there is an unlimited supply) without the use of any other fuels. Seven years' test proves the system to be perfect in every respect. Los Angeles alone, in addition to present street mains, has 150 miles of well built up streets without a gas main on them. To occupy this territory, and a large number of other towns now without gas, we have organized a parent company and a number of local companies covering some of the fastest growing cities in the United States.

Now is the time to invest, when the first capital will be able to double itself in a single year. This is also the most delightful residence section in the United States.

We suggest to those desiring gas investments, in large or moderate amounts—with or without active business connections—to come here and investigate; or, what is the next best thing, write us for particulars and prospectus.

The accompanying cut shows the oil wells in the suburbs of Los Angeles from which the Companies under the NEW LOWE GAS PROCESS obtain their supply of oil.

AMERICAN GAS & COKE CO. (T. S. C. Lowe, Manager),
406 Bradbury Building, Los Angeles, California.

THE GAS ENGINEER'S POCKET-BOOK.

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

Price, - - $3.50.

A. M. CALLENDER & COMPANY, No. 32 Pine Street, N. Y. City.

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

KLONNE-BREDEL

Recuperative Furnaces, Washers, Condensers, Purifiers and Purifying Machines, Ammonia Plant, Coke Conveyers, Etc.

Complete Works Erected with Guaranteed Results.

EASTERN AGENTS FOR

FRED. BREDEL'S SYSTEM
COAL GAS PLANTS AND GAS APPARATUS.

P. H. & F. M. ROOTS CO.'S
Exhausters, Blowers, etc.

222 South Third Street, Philadelphia, Pa.

GEORGE G. RAMSDELL, General Manager. Correspondence Solicited

FRED. BREDEL, C.E.

Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

COMPLETE GAS WORKS, COKE CONVEYERS, ETC.

No. 118 Farwell Avenue, · · Milwaukee, Wis.

Eastern Agents: AMERICAN GAS CO., Construction Department, 222 So. 3d St., Phila., Pa.

ROOTS'

LATEST IMPROVED GAS EXHAUSTER

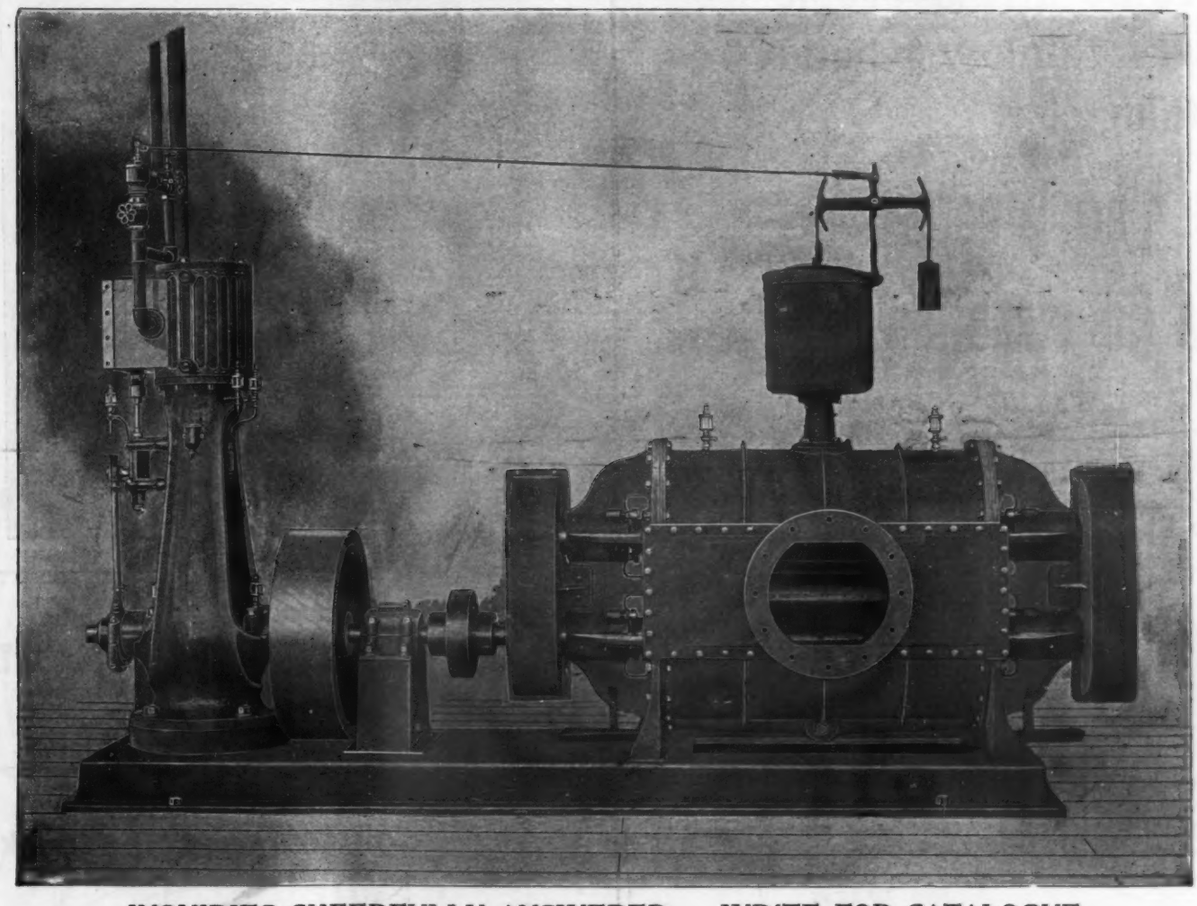
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



INQUIRIES CHEERFULLY ANSWERED. WRITE FOR CATALOGUE.

P. H. & F. M. ROOTS CO.,

Connersville, Ind. 109 Liberty St., New York.

Eastern Office:

American Gas Company,

222 South Third Street, Philadelphia, Pa.

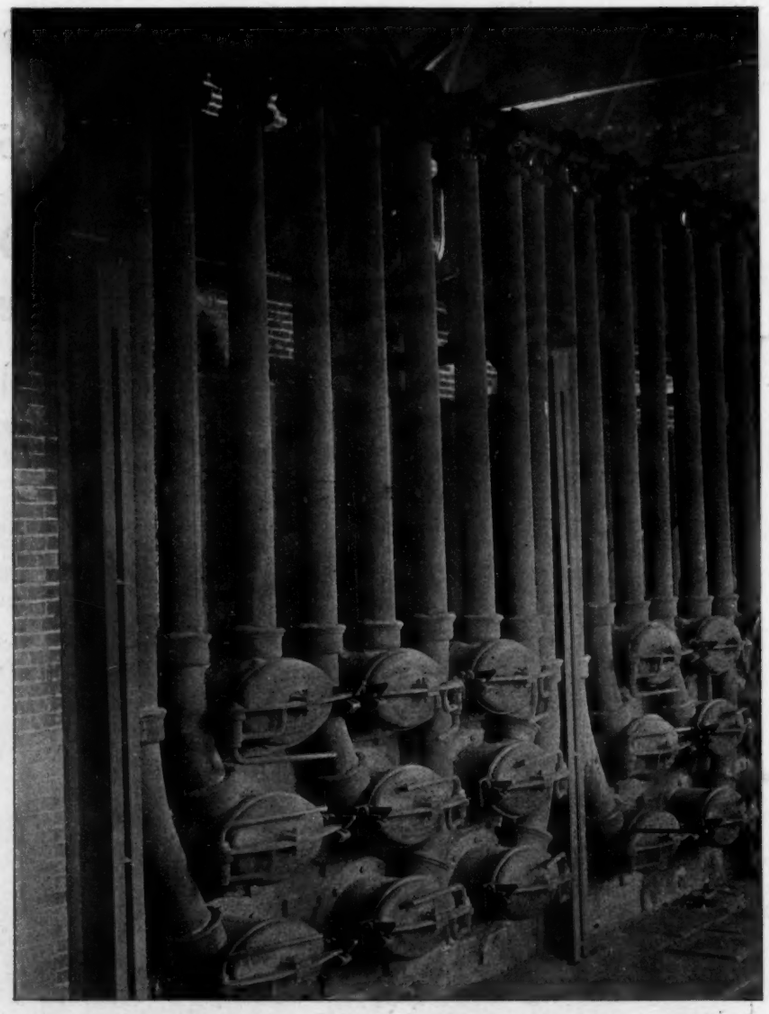
We show these just to remind you that we build them too.

We have on hand so many contracts for Improved Lowe Water Gas Apparatus, that we became afraid people might think we build nothing else.

The Western Gas Construction Co.,

FORT WAYNE, INDIANA.

WM. HENRY WHITE,
EASTERN AGENT,
32 Pine St., New York.



CHAPMAN VALVE MANUFACTURING CO.,
MANUFACTURERS OF
Valves and Gates for Gas, Ammonia, Water, Etc.
Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.
Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

THE
Ludlow Valve Mfg. Co.,
TROY, N. Y., U. S. A.
Double and Single Gate Valves, ¼" to 72",
—FOR—
Gas, Water, Steam, Oil, Ammonia, Etc.
HOT GAS VALVES A SPECIALTY.
Send for Catalogue.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE
Plans prepared and Estimates furnished at short notice.
J. P. WHITTIER,
70 Rush St., Near Division Ave., **Brooklyn, N. Y.**

The Gas Engineer's Laboratory Handbook.
By JOHN HORNBY, F.I.C.
Price, $2.50.
A. M. CALLENDER & CO., 32 Pine Street, N.Y. City

Practical Photometry.
A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.
By William Joseph Dibdin.
Price, $3.00.
A. M. CALLENDER & CO., 32 PINE ST., N.Y. CITY

(Copyrighted, 1894, by the AMERICAN METER CO.

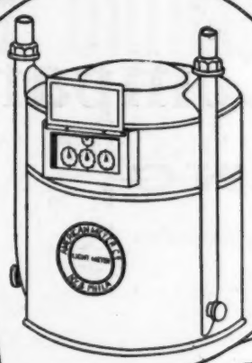
AMERICAN METER CO.

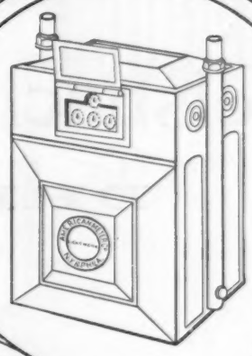
ESTABLISHED 1834. INCORPORATED 1863.

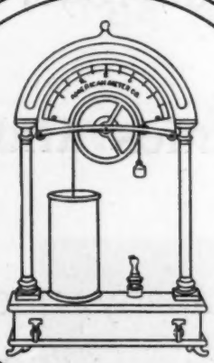
NEW YORK AND PHILADELPHIA,

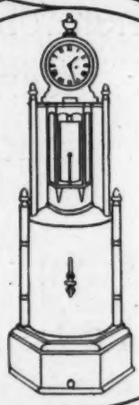
CHICAGO, ST. LOUIS,

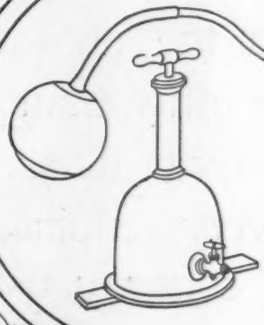
SAN FRANCISCO.

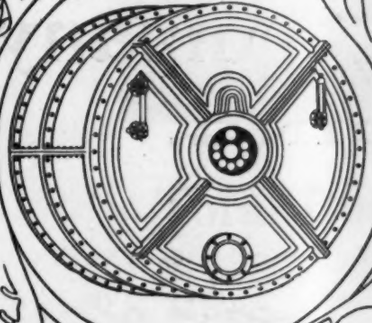


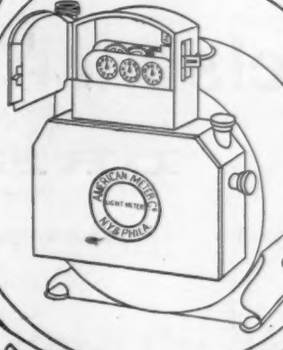












PUBLIC LIGHTING TABLE.

OCTOBER, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	6.10 PM	7.10 PM	5.30	5.00
Sun.	2	6.10	7.50	5.30	5.00
Mon.	3	6.10	8.30	5.30	5.00
Tue.	4	6.10	9.10	5.30	5.00
Wed.	5	6.10	10.00	5.30	5.00
Thu.	6	6.10	11.00	5.30	5.00
Fri.	7	6.10 LQ	12.00	5.30	5.00
Sat.	8	6.10	1.00 AM	5.20	5.10
Sun.	9	6.00	2.00	5.20	5.10
Mon.	10	6.00	3.00	5.20	5.10
Tue.	11	6.00	4.00	5.20	5.10
Wed.	12	6.00	5.10	5.20	5.10
Thu.	13	6.00	5.10	5.20	5.10
Fri.	14	6.00	5.10	5.20	5.10
Sat.	15	6.00 NM	5.10	5.10	5.20
Sun.	16	5.50	5.10	5.10	5.20
Mon.	17	5.50	5.10	5.10	5.20
Tue.	18	5.50	5.10	5.10	5.20
Wed.	19	5.50	5.10	5.10	5.20
Thu.	20	8.20	5.10	5.10	5.20
Fri.	21	9.40 FQ	5.10	5.10	5.20
Sat.	22	10.50	5.10	5.00	5.30
Sun.	23	12.00	5.20	5.00	5.30
Mon.	24	1.10 AM	5.20	5.00	5.30
Tue.	25	2.20	5.20	5.00	5.30
Wed.	26	3.20	5.20	5.00	5.30
Thu.	27	4.30	5.20	5.00	5.30
Fri.	28	No L.	No L.	5.00	5.30
Sat.	29	No L FM	No L.	4.45	5.35
Sun.	30	No L.	No L.	4.45	5.35
Mon.	31	5.30 PM	7.10 PM	4.45	5.35

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Commercial Company,

DREXEL BUILDING,

PHILADELPHIA.

New Price Lists will be issued August 15th, 1898, and a New Catalogue about September 1st.

Correspondence from Gas Companies and the trade generally is solicited.

Suits brought by the Welsbach Light Company, under its patents, against the manufacturers of infringing lights and mantles, are still pending and undetermined. We, therefore, again caution the public against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade-mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

Welsbach Commercial Company,

DREXEL BUILDING,

PHILADELPHIA.

The United Gas Improvement Company,

DREXEL BUILDING, PHILA., PA.

The Standard Junior,

The Standard Double Superheater,

LOWE WATER GAS APPARATUS.

Total Built and under Construction,

289 Sets—Daily Capacity, 185,675,000 Cu. Ft.

ALEX. C. HUMPHREYS, M. E.,
BANK OF COMMERCE BUILDING,
(31 NASSAU STREET.)
NEW YORK.

CABLE ADDRESS,
LONDON & NEW YORK,
"HUMGLAS."

ARTHUR G. GLASGOW, M.E.,
9 VICTORIA ST.,
LONDON, S. W.,
ENGLAND.

HUMPHREYS & GLASGOW.

CONTRACTING AND CONSULTING

GAS ENGINEERS.

WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

RITER-CONLEY COMPANY,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

NEW YORK, 33 NASSAU ST. PHILADELPHIA, 1932 MARKET ST. CHICAGO, 54 LAKE ST.

WELSBACH STREET LIGHTING COMPANY

OF AMERICA,

—OWNS, CONTROLS AND OPERATES—
EXCLUSIVELY

STYLE No. 81.

THE NEW IMPROVED AND PATENTED STREET LIGHT BURNER.

Our PATENTED "STREET LIGHT APPLIANCES" have made WELSBACH STREET LIGHTING a complete success.

By the UNIFORM DISTRIBUTION of light on scientific principles a greater area can be lighted by our system and more economically than in any other way.

Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

Lists of Cities and Towns in which we are now lighting under contract will be furnished upon application.

STYLE No. 97.

CORRESPONDENCE SOLICITED FROM GAS COMPANIES AND OTHERS INTERESTED IN MUNICIPAL LIGHTING.

National Gas and Water Company.

CONTRACTORS FOR
Gas Plant Machinery

SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

218 LA SALLE ST.,
CHICAGO.

Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
REPAIRS.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)
MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 357 Canal St., New York.

Hughes' "Gas Works,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.

Rewritten and Much Enlarged by
WM. RICHARDS, C.E

Eighth Edition, Revised, with Notices of Recent Improvements.

Price, $1.65.

A. M. CALLENDER & CO.,
32 Pine St., N. Y. City.

IRON MASS

For Gas Purification

Acts immediately, and more efficiently than any other purifying agent now in use.

GREENPOINT CHEMICAL WORKS,
Greenpoint Ave. and Newtown Creek, Brooklyn, N. Y.

The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

ONEILL'S OXIDE,

(NATURAL BOG ORE)

For Gas Purification.

Has the Largest Annual Sale of Any Oxide in the World.

GAS PURIFICATION AND CHEMICAL CO., LTD.,
160, 161, 162 Palmerst n Buildings,
Old Broad St., London, E. C., Eng.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREZEE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER.

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., 67 Bremen Street, Brooklyn, N. Y.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

SCIENTIFIC BOOKS.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL, SPONTANEOUS COMBUSTION OF. By Thomas Rowan, C.E. $2.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

GASFITTER'S GUIDE, by John Eldridge 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2

CONSTRUCTION OF GAS WORKS, by Walter Ralph Herring. $2.

DIGEST OF GAS CASES. $5.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

GAS MANUFACTURE, THE CHEMISTRY OF, by W. J. A. Butterfield. $3.50,

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT; A Manual of Lime and Cement, their Treatm and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $3.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 cts

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATE WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker, E.M. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague, M.I.E.E. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York,

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - 640 Equitable Building, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.

W. D. ALTHOUSE & CO.

Reading Terminal—Philadelphia.

"Shaner," Westmoreland, Pa.

HIGH GRADE GAS COAL

AND

KENTUCKY CANNELS.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

GREENOUGH'S "DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 39 Pine St., N. Y.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River: Pier No 1 (Lower Side), South Amboy, N. J.

EDMUND H. McCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

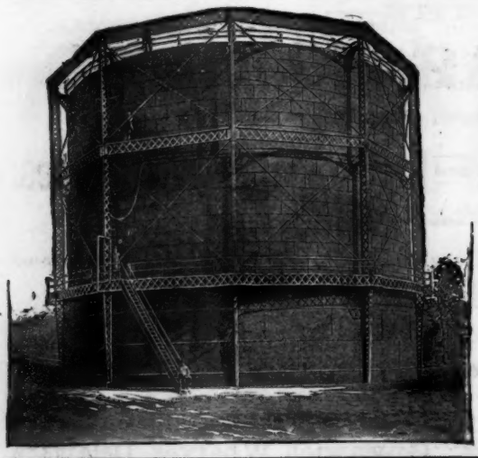
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

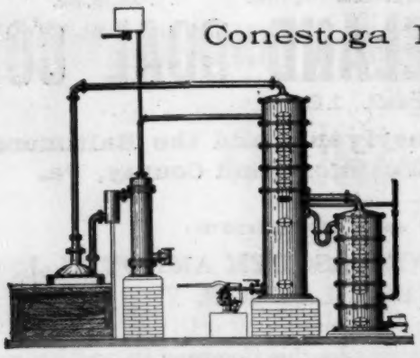
Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

GAS ENGINEERING COMPANY.

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEES AND OWNERS OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENTS FOR

FELDMANN AMMONIA MACHINE,

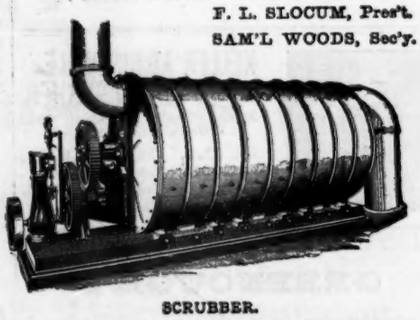
For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches.

NEW SYSTEM HYDRAULICS.

F. L. SLOCUM, Pres't.
SAM'L WOODS, Sec'y.



SCRUBBER.

Kerr Murray Manufacturing Company,

Steel Gasholder Tanks,

SINGLE, DOUBLE AND TRIPLE-LIFT GASHOLDERS,

HORIZONTAL AND VERTICAL STORAGE OIL TANKS

Iron Work for Coal Gas Benches, Self-Sealing Mouthpieces, Exhausters, Condensers, Scrubbers, Purifiers, Wooden Trays, Floor Carriages, Center Seal and Valve System Connections, Cast and Wrought Iron Fittings, and Connections 3 to 36 Inches Diameter.

VALVES, Double Gate, Hub and Flange, Outside Screw and Quick Opening, 3 to 36 In. Diam.

COAL AND COKE WAGONS, RETORT HOUSE TOOLS, STREET MAIN SPECIALS AND DRIPS.

Address,

KERR MURRAY MANUFACTURING CO.

Fort Wayne, Indiana.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

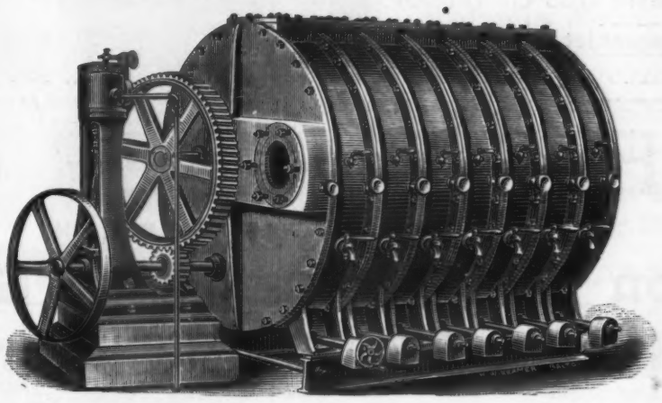
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSIBLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

WITH A VERY FULL COLLECTION OF TABLES OF HEATS OF COMBUSTION OF FUELS, SOLID, LIQUID AND GASEOUS.

TO WHICH IS ALSO APPENDED

THE REPORT OF THE COMMITTEE ON BOILER TESTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS DECEMBER (1897); TABLES OF CONSTANTS USED.

By HERMAN POOLE, F.C.S.

FIRST EDITION.

Price $8. For Sale by

A. M. CALLENDER & CO. - - No. 32 Pine Street, New York City.

R. D. WOOD & CO.,

ENGINEERS, IRON FOUNDERS, MACHINISTS.

400 Chestnut Street, Philadelphia, Pa.

MANUFACTURERS OF

CAST IRON PIPE.

BUILDERS OF

Gas Holders,

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks.

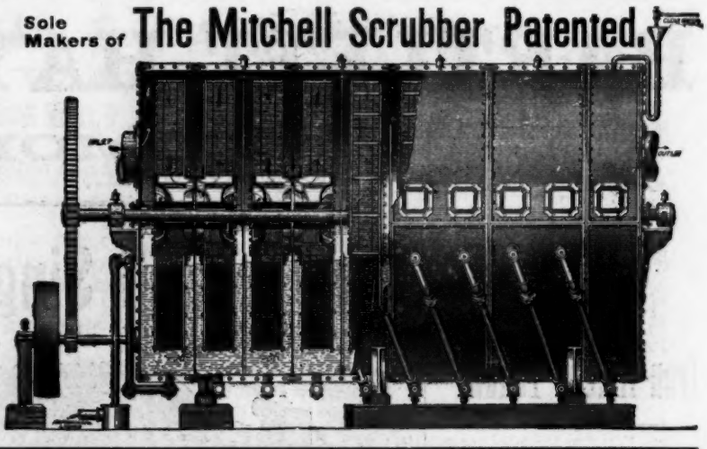
PURIFIERS, CONDENSERS, SCRUBBERS.

The Hopper Automatic Gas Governor

Send for Pamphlet.

Dunham Patent Specials.

Sole Makers of **The Mitchell Scrubber Patented.**



ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

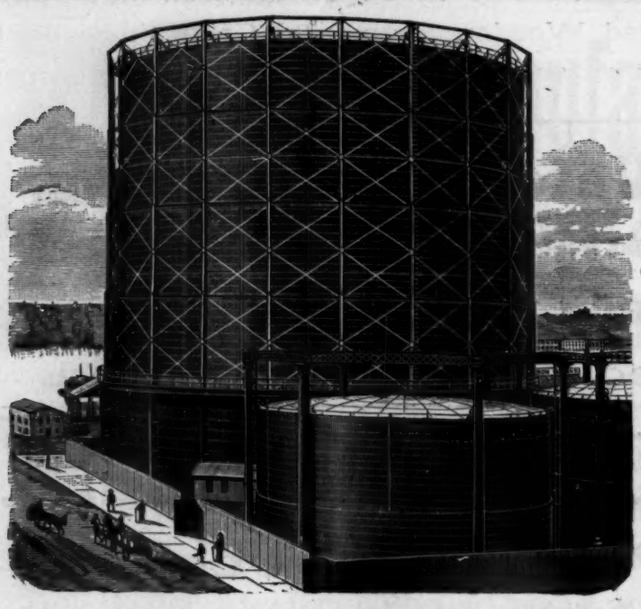
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. OFFICES **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

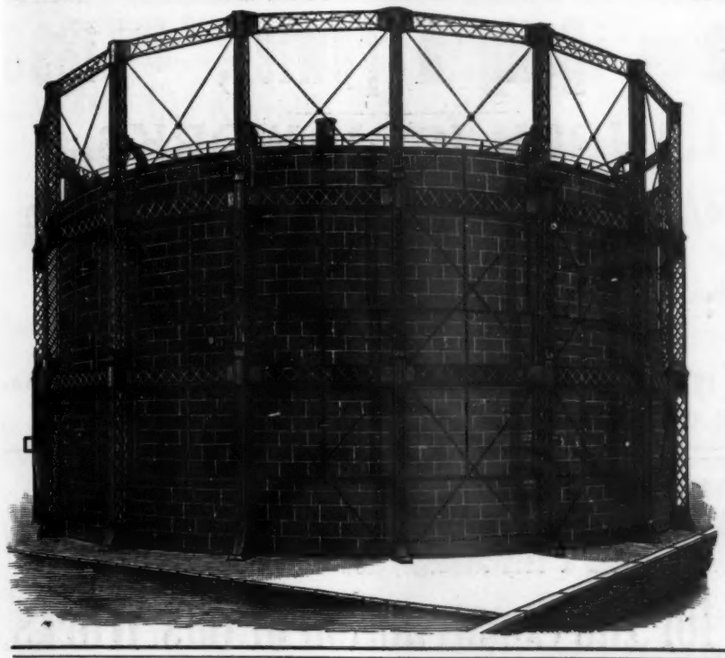
BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
948 N. 8th St., Phila., Pa



H. RANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO

Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

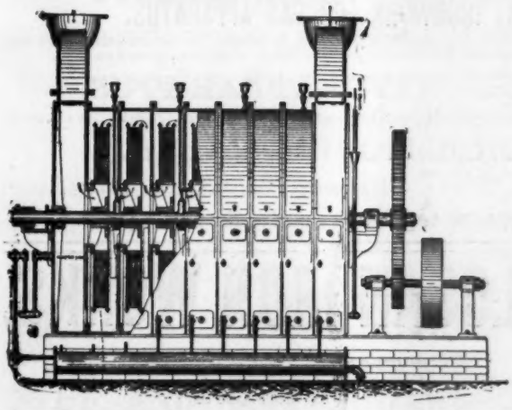
Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.



GEORGE SHEPARD PAGE'S SONS,

AGENTS FOR

The Ammonia Washer-Scrubber

The Ammonia Scrubber (late "Standard") has been before the American Gas Engineers for the past nineteen years. During that time many improvements have been made by the builders, the Isbell-Porter Company, until to-day it stands at the head of all Scrubbers. The fact of there being nearly ninety in use, with a combined capacity of 70,000,000 cubic feet per 24 hours, is of itself sufficient indorsement of its merit. There is no other Scrubber built giving so little back pressure and so much area per thousand cubic feet. Do not be induced to put in a Scrubber until you have acquainted yourself with the AMMONIA SCRUBBER.

Write for Circulars and Blue Prints.

69 Wall Street, = = New York City.

GEORGE R. ROWLAND.

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

W. H. PEARSON, Prest. J. W. WESTCOTT, Gen'l Mangr. and Treas. L. L. MERRIFIELD, Chief Engr.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, Limited

269 Front Street, East, Toronto, Canada.

ENGINEERS AND BUILDERS OF THE **IMPROVED LOWE WATER GAS APPARATUS.**

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.

WM. HENRY WHITE,

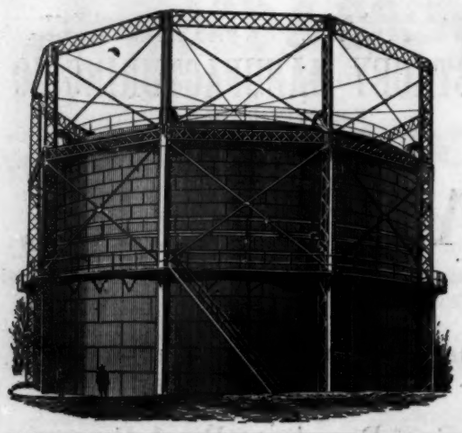
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1898

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD'S SONS,

Successors to HERRING & FLOYD,

Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

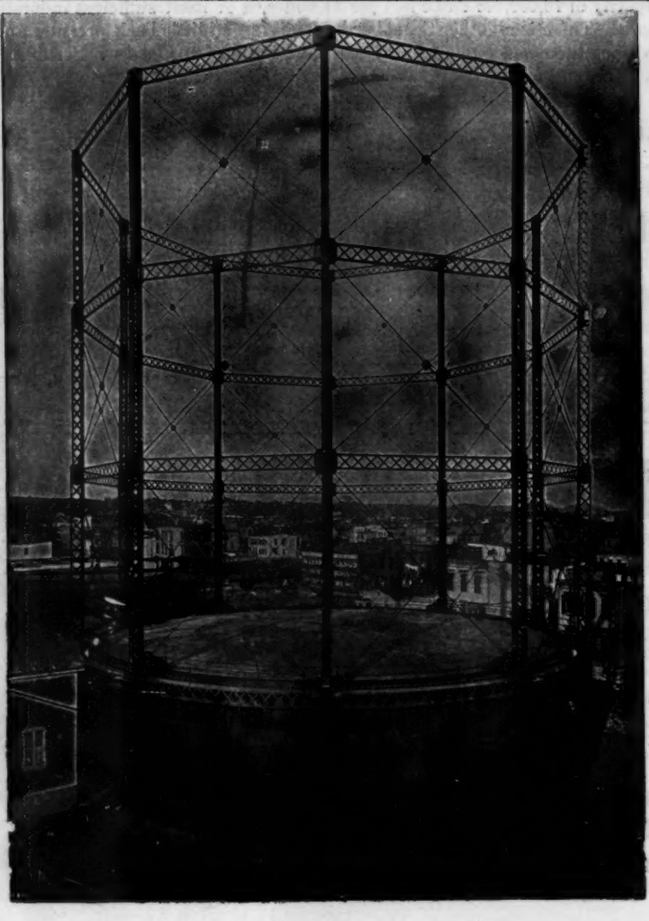
WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

Stroh & Osius Concentrator for Ammoniacal Liquor, used by 50 Gas Companies and Cokeries during the past 4 years.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu. Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,

CONDENSERS,

PURIFIERS, IRON ROOFS,

Self-Sealing Retort Lids,

AND ALL PARTS OF

GAS WORKS APPARATUS

Contractors for Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S

HOT GAS SCRUBBER.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

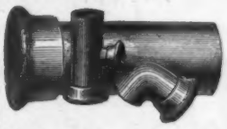
GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches. Bends, Retorts, etc., etc

DAVID LEAVITT HOUGH,

26 CORTLANDT ST., N.Y. CITY.

Consulting Engineer.

Investigations and Appraisals.
Designs and Estimates.

Contractor.

Machinery and Structures.
Gas and Water Pipe.

Special Agent for Selling & Purchasing.

"GLOBE" SPECIALS, VALVES, ETC. "GLAMORGAN" FIRE HYDRANT

M. J. DRUMMOND & CO.

MANUFACTURERS OF

CAST IRON FLANGE GAS AND WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

Western Office: Monadnock Block, Chicago, Ills.

GEORGE ORMROD, Manst. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

Practical Hints

ON THE CONSTRUCTION AND WORKING OF

Regenerator Furnaces,

By MAURICE GRAHAM, C.E.

Price $1.25.

A. M. CALLENDER & CO., 32 Pine Street, N.Y.

CHARLES MILLAR & SON, Selling Agents, Utica, N. Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

CAST IRON PIPE and SPECIALS FOR WATER AND GAS.

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

—ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 30,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

Correspondence Solicited.

511 West Twenty-first Street, NEW YORK. | **51, 53 & 55 Lancaster Street, ALBANY, N. Y.** | **34 & 36 West Monroe Street, CHICAGO.**

NATHANIEL TUFTS METER CO.,

8 Medford Street, Boston, Mass.

MANUFACTURERS OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

YOU SHOULD PROVE YOUR METERS

With a Five-Foot Prover Made by the

KEYSTONE METER CO.,

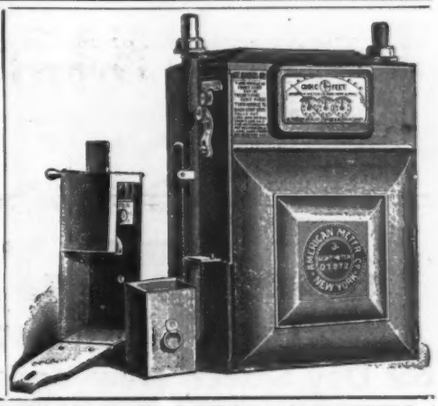
ROYERSFORD, PA.

American Meter Co.

NEW YORK, PHILADELPHIA,
SAN FRANCISCO.

Prepayment Meters.

Their construction is such that they may be readily readjusted when the scale of gas rates is changed.



HELME & McILHENNY,

Established 1848. **1339 to 1349 Cherry Street, Philadelphia, Pa.**

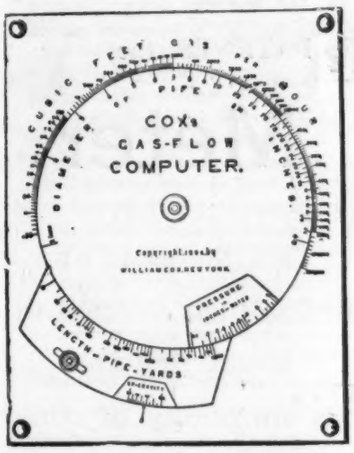
MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.



Do you wish to Know

what size of Pipe to use to convey any quantity of Gas, any distance, with any loss of pressure, and any initial or final pressure? Then use

COX'S GAS FLOW COMPUTER,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

This is the best time to look after your repairing.

Seventy per cent. of old meters run slow. You are losing money on them. Let us put them in shape for you, a few at a time, until your entire meter equipment is made as good as new. It is better to attend to this matter now, before the Gas Stove season is at its height. Probably we can do such work in our factory better and cheaper than you can do it at home, and just now we can do it promptly.

The BUHL METERS are as good Meters as you can get.

DETROIT METER COMPANY, = = Detroit, Mich.

The Advertisement of the

OTTO GAS ENGINE WORKS,

33d and Walnut Streets, Philadelphia,

New York, 39 Cortlandt St., Boston, 19 Pearl St., Chicago, 245 Lake St.,

Occupies this space every alternate week.

JOHN J. GRIFFIN & CO.,

1513-1515-1517-1519-1521 Race Street, Philadelphia.

52 Dey Street, New York. WM. S. GRIBBEL, Manager.

75 N. Clinton St., Chicago. FREDERICK WAUGH, Manager.

MANUFACTURERS OF

STATION METERS, CONSUMERS' METERS,

Provers, Registers, Gauges, Experimental Apparatus, Etc.

Prompt Attention Given to All Repairing.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 30,000 now in use.

We manufacture in the United States, under the **SAWER & PURVES PATENTS**, the

Positive Prepayment Meter.

. . SIMPLE . .

. DURABLE .

. ACCURATE .

. RELIABLE .

All Parts Interchangeable

This Meter is an unqualified success in Great Britain. Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

Needs Only the Care Given an Ordinary Meter.

Saves MONEY, TIME and CONSUMERS.

Dispenses with "DEPOSITS" and Increases OUTPUT.